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STUDY RELATING THE IMPACTS OF ORV'S ON SOILS THAT MAY RESULT FROM PROPOSED MOTORCYCLE RACE

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Introduction

A cross country "Hare and Hound" motorcycle race was scheduled for October 25, 1980. The race was to originate in the Johnson Valley open area and proceed north to the area known as Hector. The course proceeded easterly, remaining south of highway 66 to Amboy. From Amboy south and then east along the western and southern edges of Bristol Dry Lake. Southeast of Amboy, the course intercepts and follows a power line road to the Patton trail along Cadiz Valley to pit #3 near Iron Mountain. After the fourth pit area the route connects with the "score 400" route to the finish area near Vidal Junction.

It became almost immediately obvious to this investigator that a tremendous amount of field work had preceeded the race. The course followed existing roads and trails that must have been well marked because most of the participants remained on course. The existing roads and trails were compact and generally void of vegetation prior to this event and were excellent choices for the route. The sections that were "cross country", where trails did not exist prior to the event, were generally located on level coarse textured surface and sub surface soils that usually are considered to have slight wind or water erosion hazard.

Perennial vegetation is sufficiently sparse along the "cross country" portions that very few perennial plants were damaged by what appeared the result of vehicular contact.

General Nature of the Area

Climate

The Johnson Valley to Parker race course is in the Mojave Desert. The Mojave Desert is very arid with a mean annual precipitation of about 4 inches. The Barstow Climate Station located at 2160 feet has a 66 year average precipitation of 4.13 inches. The Iron Mountain Weather Station is located at 922 feet with a 47 year average precipitation of 2.93 inches. The Twentynine Palms Weather Station is located at 1975 feet elevation and has a 47 year precipitation average of 3.79 inches. The majority of precipitation in the area occurs as rain between the months of November and April. Throughout the area locally intense thunder showers occur from late June to November with the path of the storm often receiving one or more inches of high intensity, short duration rainfall.

Geology

The study area is composed of soils from recent deposits of primarily granitic origin. Much of the study area is on unconsolidated sediments of dissected and undissected fill. The recent alluvium consists of coarse gravel and cobbles in sloping alluvial fans bordering upland areas grading downward to pebbles and sands in the valleys.

Soils formed from the recent alluvial deposits are generally coarse textured and overlay older unrelated alluvial mantles over weathered granitic rock.

Relief

The route follows nearly level topography with the entire course altitude ranging from slightly less than 1000 feet to just over 3000 feet. The majority of the cross country route is nearly level (less than 2% slopes).

Drainage

Drainage ranged from excessively well drained in the coarse textured alluvium to poorly drained in the finer textured lake bed areas.

Vegetation

The majority of the route is considered "Mojave Creosote Brush Scrub" vegetation. The Cresote Brush Scrub is a very long lived perennial vegetation that is well adapted to arid regions. In the vicinity of Bristol Dry Lake are some very salt tolorant species occur in the "Alkali Sink" areas. In the Cadiz Valley area are some "Partially Stabilized Desert Dunes". Throughout the area the dominant species is Creosote Bush.

Materials and Methods

The route of the race course was followed and air-photo coverage was obtained. Using the aerial photographs as a guide, plots were located along the route to monitor the effect of the vehicle activity off existing roads and trails on each soil that was identified with a specific vehicular intensity. Intensity of use was divided into the following catagories: Intensive (I) - path less than 12 feet wide

Moderate (M) - path 12 to 20 feet wide

Light (L) - path greater than 20 feet wide

Soil samples were collected from a 1 M^2 plot on the course and adjacent to the course during May 1982. Samples from the surface 5 cm were transported to the laboratory for textural analysis using the pipet method, and pH by glass electrode. Subsurface samples were collected from 10 to 15 cm deep, placed in a sealed container inside a covered box, and transported within 24 hours to the laboratory where moisture content was determined gravimetrically on duplicate samples.

Soil compaction was measured during May of 1982 using a recording penetrometer (Delmi Company, Shafter, Ca.) by measuring penetrability at least 10 times for samples with soil penetrability values less than 70 Kg/cm^2. Several plots did not result in readings because the limit of the recording penetrometer (70 Kg/cm^2) was exceeded.

Aerial photographs on 18 October 1980 were an attempt to locate the route for pre-race data, with post race aerial coverage obtained 1 November 1980. Subsequent observations and photographs were obtained during the race on 10 October 1981, with post event coverage completed 11 May 1982.

Selected Study Sites

Study sites were located along the course on different soils to allow relatively broad range coverage. Study sites were not located on what appeared to have been roads or existing trails prior to the 1980 event. Existing roads and trails were generally void of vegetative cover and much more compact than the surrounding areas. Hence the selected study sites should show the short range effect of ORV activity on soil properties.

Figure 1 shows the location of plots 1 and 2 as the course approaches old highway 66 approximately three miles east of Hector. Plot 1 is located where the vehicles covered a path approximately 30 feet wide, or 15 feet on each side of the centerline. The use intensity of plot 1 is categorized as Light. Soil site investigation showed the soil on the course contained more moisture than the adjacent (non use) plot located south of the course. The penetrability (Table 1) on and adjacent to the course was high (greater than 40) enough to possibly impede plant growth. Figure 2 is an enlarged view of the same area shown in Figure 1. In figure 2 (May 1982) it is relatively difficult to locate the race course, although it is very easy to locate from the ground. Plot #2 is about 100 feet east of plot #1; located on wind deposited sand sized materials with a course width of about three feet categorized as a zone of extreme use. Penetrometer readings show severe compaction within 10 cm of the soil surface where the plot located approximately 2 feet off the trail did not have a similar compacted zone.

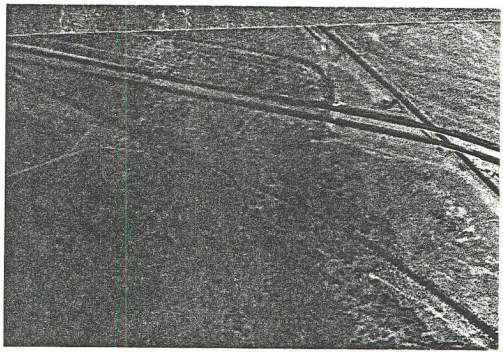


Figure 1. Aerial view of plots 1 and 2. (Photo 1 November 1980)

Figure 2. Aerial view of plots 1 and 2. (Photo 11 May 1982)

Similar compaction has been reported as a result of intense vehicular activity.

Plot 3 is located in pit number 1, creek bed west of the dirt road and southeast of the town of Ludlow. Plot 4 is approximately ½ mile south (up stream or down course) from plot 3. Plots 3 and 4 are coarse textured (96.5 and 94.1% sand respectively) and the traffic was spread over 30 or more feet for what is considered light use. There was slight measurable compaction of plots 3 and 4 relative to adjacent (non use) plots.

Plots 5 and 6, located along the north edge of the Twentynine Palms Marine Base where the trail tends to spread in excess of 50 feet in width. There is only slight compaction and increase in subsurface moisture in these light intensity use plots.

Plot 7 is located on what appears to be an older terrace with rather well established desert pavement. The marked course was west of plot 7 and was to follow a much coarser textured wash until the route intersected the road. The traffic was moderate and did result in some compaction as shown by penetrometer readings of 40 on the trail compared to 17 off the trail. Plot 7 was only used during the 1980 run and likely would not have been used if adequate flagging had occurred. Figure 6 shows plots 8 and 9 as the route approaches the Amboy Crater and crosses two sections of disturbed desert pavement on old terrace. Plot 8 is the Creosote scrub vegetation between the terrace and plot 9 is the eastern terrace. There was little difference in

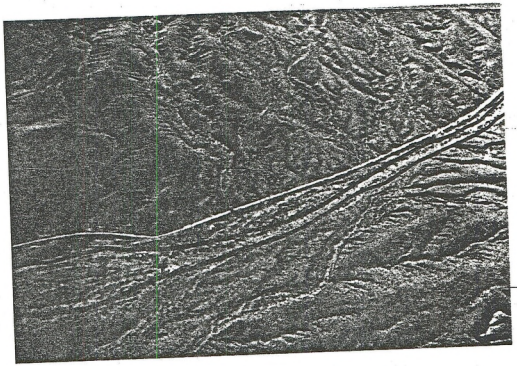


Figure 3. Pit area 1 located just southeast of Ludlow showing plots 3 and 4. (Photo 25 October 1980)

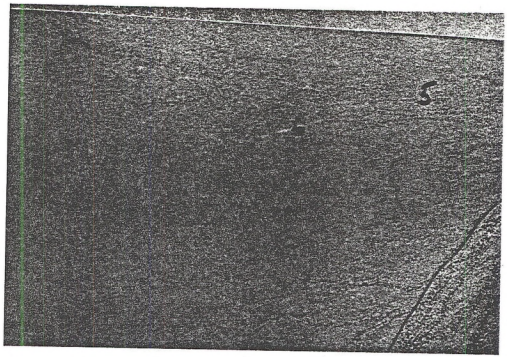


Figure 4. Cross country section of the course just North of Twentynine Palms Marine base showing plots 5 and 6. (Photo 1 November 1980)

Figure 5. As the route returns to the power line road South of Bagdad showing plot 7. (Photo 1 November 1980)

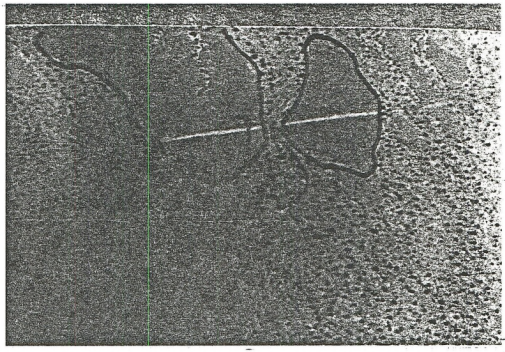


Figure 6. Cross country section between Bagdad and Amboy showing plots 8 and 9. (Photo 11 May 1982)

the soil penetrability and moisture content of use and non use plots, however these plots were located close to Amboy where only traces of precipitation had fallen in 1980-1982, according to Buster Burrios the unofficial Amboy Mayor and manager of Roy's Cafe in Amboy. Figures 7 and 8 show plots 10 and 11 along the north edge of the Amboy Crater as the course nears the flow area. Plot 10 is extremely dense on and off the route (greater than 70 Kg/cm^2) and penetrometer readings could not be obtained. Plot 11 was very soft and penetrable where the two lowest penetrometer readings of the entire course were obtained. The vehicular path width for plot 11 was approximately 35 feet or what is considered light use intensity. Plot 12 is shown in Figure 9. Plot 12 is on a trail that traverses the lava flow near the town of Amboy. Plot 12 is a Torripsamment (Cajon) with only sparse vegetation, possibly located on the lowest point on the entire course with an elevation of approximately 700 feet. The trail width is about 10 feet and resulted in some soil compaction as determined by 10cm penetrometer readings of 29Kg/cm^2 on the trail compared to 18Kg/cm^2 off the trail.

The approach to and pit #2 are plots 13 and 14 respectively. Both plots are located along the south edge of Bristol Lake with the road between Amboy and Twentynine Palms visible. Plots 13 and 14 are a typical in that both soils showed lower penetrometer readings on the course than the plots located just off the trail. One possible explanation of this anamoly is the high salt content along the edge of the lake that is not present on most other sections of the course.

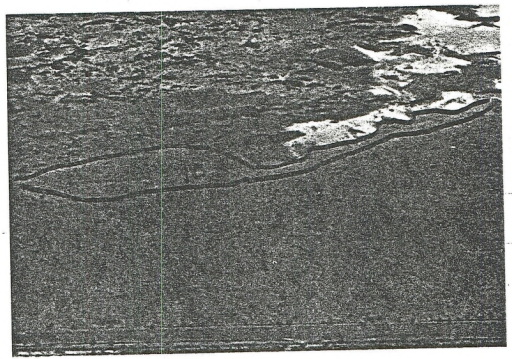


Figure 7. Cross country portion just North of the Amboy Crater showing plot 10. (Photo 10 October 1981)

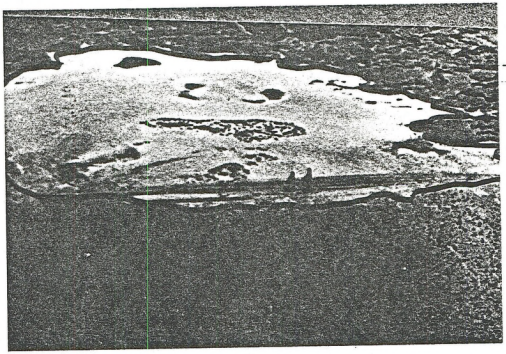


Figure 8. Fine textured soil North of the Amboy Crater showing plot 11. (Photo 10 October, 1981)

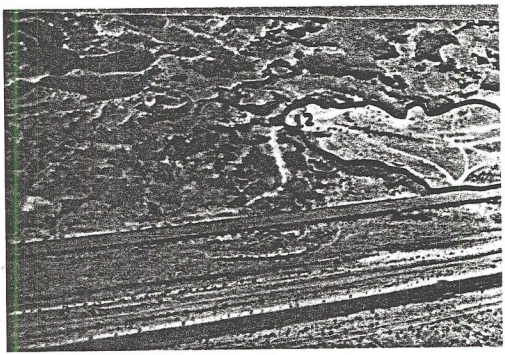


Figure 9. Narrow trail through the lava flows North of Amboy Crater shows plot 12. (Photo 1 November, 1980)

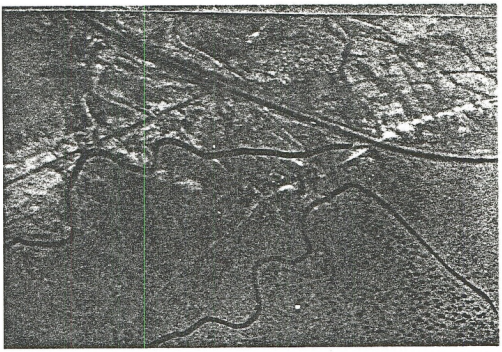


Figure 10. Approach to pit #2 showing plots numbered 13 and 14. (Photo 10 October, 1981)

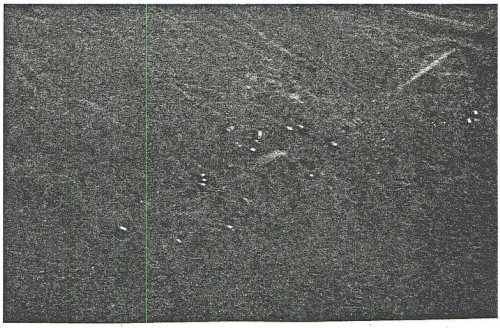


Figure 11. Enlargement of plot #14, Pit #2 during the 1981 event. (Photo 10 October, 1981)

Plot 15 is shown in Figure 12 located about 5 miles east of pit #2 on a portion of the trail that is approximately 10 feet wide. Penetrometer readings show some compaction although not as extreme as that of plot 16 where the trail narrowed to three feet as the vehicles circumnavigated a rather large creosote bush. Shortly after plot 16 the trail separated and followed two paths with most of the vehicles following the southern route.

Figure 14 is located along the southeast edge of Bristol Lake where the cross country portion joins the power line road The path width of plot 17 is categorized as intensive with penetrometer readings of 27 Kg/cm^2 on the trail compared to 11 Kg/cm^2 just off the trail indicating soil compaction had occured. Plots 8 through 17 are located on trails within about 10 miles of the town of Amboy which is generally less than 1000 feet elevation and likely the dryest portion of the entire route.

Plot 18 is located in section 17 of T4NR14E along the northwest edge of Cadiz Valley where the trail left Patton's Trail and went around a knoll during the unsanctioned 1980 event. Traffic appeared rather light most likely a result of many riders having stopped prior to plot 18 plus ease of "cutting the course" by remaining on the existing road either by accident or intent. With the light use, some soil compaction occured at both the 10 and 25cm depths.

Figure 15 shows the location of plots 19 and 20 along the diversion from Patton's Trail and located in Section 33 TNR15E. Penetrometer readings show slight soil compaction for each plot over the adjacent control plots. Plots 19 and 20 are located

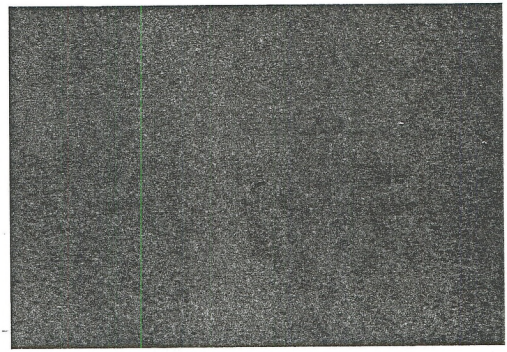


Figure 12. Location of plots 15 and 16 a few miles east of Pit 2 and south of the Amboy to Twentynine Palms road. (Photo 11 May 1982)

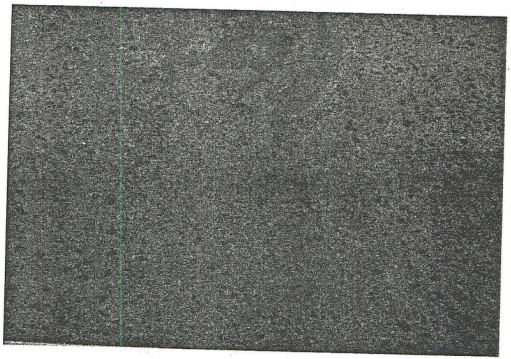


Figure 13. Close up of Figure 12 showing two distinct trails as the riders separated. (Photo 11 May 1982)

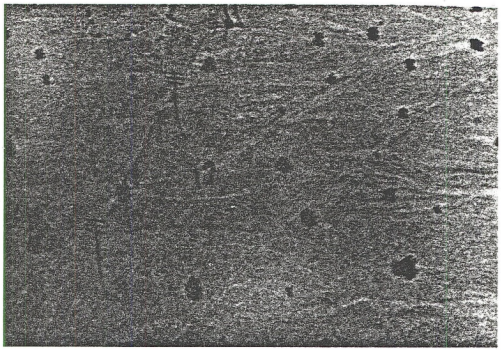


Figure 14. Plot 17 located where the cross country trail joins the powerline road on the east edge of Bristol Lake. (Photo 11 May, 1982)

Figure 15. Plots 19 and 20 located in section 25 of T1NR14E. (Photo 11 May, 1982)

where vegetation was and is very sparse.

Figure 16 shows the disturbed surface of site 7, shortly after the 1980 event. A close up of site 7, shown in figure 17, gives a view of a highly disturbed surface. Penetrometer studies did show compaction and surface appearance indicates some susceptibility to wind erosion. Surface disruption and compaction on the developed soil was much greater than on the coarse textured wash material such as sites 3,4,5, and 6. Although the site appeared very sensitive, figure 18 shows some stabilization after only very slight precipitation between October 1980 and October 1981 (well below average). Figure 19 shows rather well stabilized fine sand at site 2. It is hoped that additional precipitation of the 1982-83 season will continue to stabilize the soil. The short term nature of this study does not allow long range follow up. Long term studies are imperative to truly describe the net result of this race. It is suggested some monitoring of soil moisture, vegetative cover and soil penetrability be conducted during 1985 and 1990. These dates, 5 and 10 years after the first event, may show if soil and/or vegetative changes have occurred.

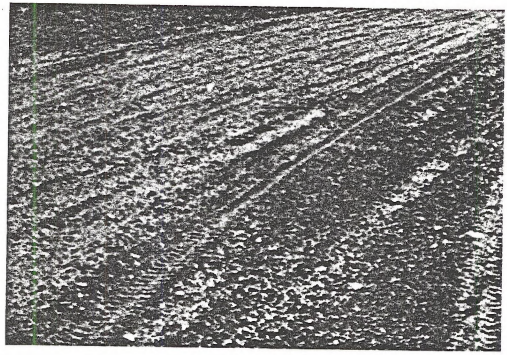


Figure 16. Oblique view of plot 7 shortly after the 1980 event.

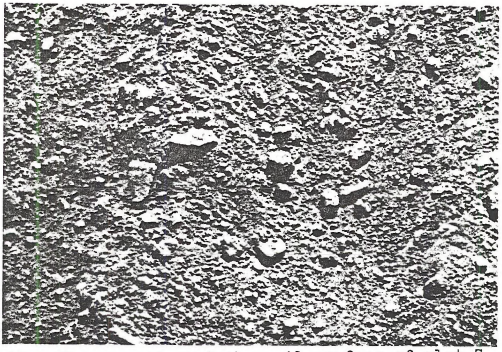


Figure 17. Close up view of the soil surface of plot 7 shortly after the 1980 event.

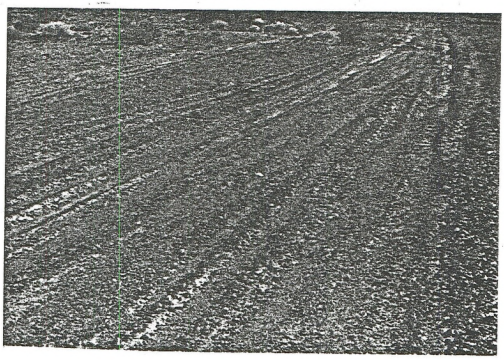


Figure 18. Oblique view of plot 7 prior to the 1981 event.

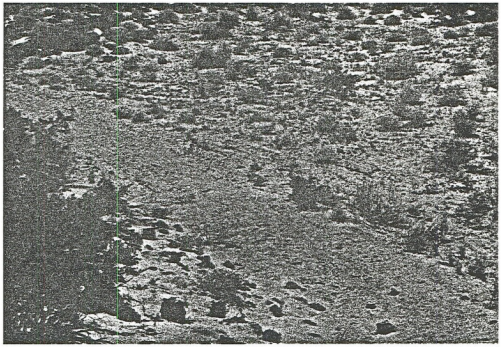


Figure 19. Oblique view of plot 2 prior to the 1982 event.

Study Site Summary

A summary of the data from the selected study sites is shown in Table1. The sample labeled A was located on the trail with B, located on the same soil just off the trail in an area void of any apparent vehicular activity. The surface of sample A was generally rougher than B and often had broken plant residues incorporated in the top 1 to 2cm. The average moisture content of sample A (4.22%) compared to B (3.59%) shows the apparent results of the roughened soil surface (more infiltration and less run off) plus having less or no vegetative cover, probably before as well as after the event.

Inspection of the 10cm penetrometer readings show average readings of 31.9 Kg/cm^2 on the trails versus 16.6 Kg/cm^2 off the trails. Further breakdown shows there were 5 intense locations (on trails less than 12 feet wide), 8 moderate (trails 12-20 feet wide) and 7 light use (trails greater than 20 feet). The average width for the less than 12 foot width (intense) was 7.2 feet, the 12 to 20 feet average is 15 feet with a 43.6 foot average for the greater than 20 foot sites. In the absence of data relating soil compaction to water infiltration and retention or plant germination, emergence and growth in the desert areas, it seems logical that more compact soils will reduce both the rate of water infiltration and plant growth similar to cultivated soils in non-arid locations. In the intense use areas there is a large difference between the penetrability on and off the trail. The difference between on and off the trail is 26.6 Kg/cm^2 which is much greater than

Table 1. Summary of data from the 20 selected study sites

site	plot	Texture	%H_2O	pH	penetrometer (Kg/cm^2) 10cm	penetrometer (Kg/cm^2) 25cm	Max width (ft)	Avg.
1	A	loamy sand	5.85	8.0	45	na	30	6
	B		5.33		58	58		
2	A	sand	2.82	8.0	70	na	3	2
	B		0.95		10	17		
3	A	very gravelly	2.25	8.2	57	na	40	10
	B	coarse sand	2.37		48	na		
4	A	very gravelly	2.53	8.2	55	na	30	10
	B	coarse sand	3.91		50	na		
5	A	very gravelly	2.71	8.2	34	42	50	15
	B	sand	2.29		29	45		
6	A	very gravelly	2.92	8.2	27	36	50	15
	B	sand	2.7		24	42		
7	A	gravelly fine	3.10	8.0	40	na	15	6
	B	sand	2.93		17	33		
8	A	very gravelly	2.15	8.2	42	na	15	6
	B	sand	2.29		57	na		
9	A	loam	2.87	7.6	31	39	15	8
	B		2.35		25	35		
10	A	loam	7.02	8.2	na	na	25	5
	B		6.19		na	na		
11	A	loam	1.46	8.2	8	21	15	5
	B		1.64		6	14		
12	A	loamy sand	1.94	7.8	29	46	10	3
	B		1.87		18	37		
13	A	sand	1.56	8.0	10	37	15	5
	B		2.50		22	52		
14	A	sand	8.94	8.2	9	17	80	20
	B		7.54		11	20		
15	A	fine sand	3.85	8.0	25	22	10	5
	B		2.71		11	35		

SOIL	K	T	WATER EROSION Medial S%	A'	Rating	WIND EROSION WEG	Rating	SOIL STRENGTH Unified Class	Rating	OVERALL RATING Calm	Windy
#14 Cajon Sand, Saline, 0 to 1% slopes	0.15 0.10	2 5	1	0.44 0.29	Slight Slight	1	Severe	SM SP-SM	Moderate	Slight to Moderate	Severe
#15 Mohave fs, #16 1 to 2% slopes	0.15 0.43	2 5	2	0.68 1.97	Slight Slight	1	Severe	SM SP-SM	Moderate	Slight to Moderate	Severe
#17 Cajon gs, 2 to 4% slopes	0.10	2 5	3	0.64	Slight Slight	5	Moderate	SM SP-SM		Slight to Moderate	Moderate
#18 Mohave gs, 0 to 1% slopes	0.15 0.43	2 5	1	0.44	Slight Slight	1	Severe	SM SP-SM	Moderate	Slight to Moderate	Severe
#19 Cajon COS, #20 2 to 4% slopes	0.15	2 5	3	0.97	Slight Slight	1	Severe	SP SP-SM	Moderate	Slight to Moderate	Severe

the standard deviation. The moderate use plot averages between trail and off trail locations was slight with rather large standard deviations that greatly exceed the observed differences. With the vehicular activity spread over greater than 20 feet much random variation seemed to exist. The trail portions appear to be more compact than the adjacent areas, few if any conclusions can be drawn with the large standard deviations on the light use areas.

Table 1. (continued)

site	plot	Texture	%H_2O	pH	penetrometer (Kg/cm^2) 10cm	25cm	Max width (ft)	Avg.
16	A	fine sand	15.62	8.0	38	26	3	2
	B		10.26		6	18		
17	A	gravelly sand	7.77	8.0	27	39	10	3
	B		7.89		11	29		
18	A	gravelly sand	2.20	8.0	22	36	15	5
	B		1.80		14	21		
19	A	coarse sand	2.14	8.0	21	19	15	4
	B		2.21		15	17		
20	A	coarse sand	2.74	8.0	16	19	15	5
	B		2.31		14	14		
		DATA SUMMARY						
	A	(20 plot average)	4.22		31.9	σ=16.4	23.05	7.0
	B	(20 plot average)	3.59		16.6	σ=14.6		
USE								
Intense								
<12ft	A	(5 plot average)			37.8	σ=16.7	7.20	
	B	(5 plot average)			11.2	σ= 3.9		
Moderate								
12-20ft	A	(8 plot average)			21.2	σ=14.2	15.0	
	B	(8 plot average)			20.0	σ=15.5		
Light								
>20ft	A	(7 plot average)			37.7	σ=16.7	43.6	
	B	(7 plot average)			25.0	σ=22.0		

ADDENDUM to Page 24

TABLE 2

SOIL LIMITATIONS AND RATINGS FOR ORV WHEELED VEHICLES USING COMMITTEE 3 WRTSSWPC CRITERIA

SOIL	WATER EROSION K	T	S%	A'	Ratlng	WEC	WIND EROSION Ratlng	SOIL STRENGTH Unified Class	Ratlng	OVERALL RATING Calm	Windy
			Medial								
#1 Mohave ls, 0 to 1% slopes	0.28	2 5	1	0.81	Slight Slight	2	Severe	SM	Moderate	Slight to Moderate	Severe
#2 Cajon Sand, 2 to 9% slopes	0.15	2 5	6	2.13	Moderate Slight	1	Severe	SM SP-SM	Moderate	Moderate	Severe
#3											
#4 Arizo vgCos, 2 to 9% slopes	0.10	2 5	6	1.42	Slight Slight	5	Moderate	GP	Slight	Slight	Moderate
#5											
#6 Arizo vgS, 0 to 2% slopes	0.10	2 5	1	0.29	Slight Slight	5	Moderate	GP	Slight	Slight	Moderate
#7 Typic Camborthid S.S., mixed thermic 2 to 3% slopes(Er.Pav)	0.10	2 5	3	0.64	Slight Slight	8/5	Slight Moderate	GP/ML	Slight Severe	Slight	Slight Moderate
#8 Arenic Haplargids S.S., mixed, th., 2 to 3% slopes, (Er. Pav)	0.10	2 5	3	0.64	Slight Slight	1	Severe	SP,SW	Moderate	Slight to Moderate	Severe
#9 Mohave loam, 0 to 2% slopes, Clayey	0.43	2 5	1	1.25	Slight Slight	5	Moderate	ML or CL	Severe	Moderate	Moderate
#10 Typic Camborthid #11 Co.l., mixed, Th., 0 to 1% slopes	0.32	2 5	1	0.93	Slight Slight	5	Moderate	ML	Severe	Moderate	Moderate
#12 Cajon l.s., 2 to 15% slopes	0.15	2 5	8	3.15	Severe Slight	2	Severe	SM	Moderate	Moderate to Severe	Severe
#13 Typic Torri orthents, s/l, mixed, thermic 0 to 1% slopes	0.15 0.49	2 5	1	0.44	Slight Slight	1	Severe	SM SP-SM	Moderate	Slight to Moderate	Severe

Climate

Probably the best description of climate in the desert is "average years rarely occur". There are three official weather stations along the portion of the race covered by this report. The Barstow Climate Station had maintained weather records for nearly seventy years prior to moving to the Barstow Fire Station in 1979. Although the data base, weather station location, has changed the mean annual precipitation of 4.13 inches from the Barstow Climate Station is a good indication of precipitation in the area. The Iron Mountain and Twentynine Palms weather stations each have maintained records for 47 years with mean annual precipitation of 2.89 and 3.79 inches respectively.

Establishment or reestablishment of vegetation especially in the desert is very dependent on adequate moisture. Inspection of precipitation including precipitation pattern of the 1980-81 seasons shows conditions not well suited to establish or support new vegetative growth. Table 2 shows the monthly and mean annual precipitation for the three selected weather stations.

Table 2. Climate summary for 1980-1981. (inches precipitation)

Date	Barstow Fire Station	Iron Mountain	Twentynine Palms
1/80	2.41	1.19	0.83
2/80	2.82	1.58	2.45
3/80	1.34	0.72	1.08
4/80	0.46	0.52	0.17
5/80	0.24	0.03	0.37
6/80	T	0.00	0.00
7/80	0.51	0.17	0.61
8/80	0.00	0.00	0.00
9/80	0.31	0.14	1.65
10/80	0.00	0.02	0.03
11/80	0.00	0.00	0.00
12/80	0.00	0.00	0.00
1980 $\bar{x}$	8.11	4.37	7.19
1/81	0.62	0.17	0.84
2/81	0.40	0.22	0.12
3/81	0.62	0.99	1.12
4/81	0.04	0.00	0.00
5/81	0.11	0.39	0.46
6/81	0.00	0.04	0.00
7/81	0.00	0.33	0.23
8/81	0.20	1.12	0.00
9/81	0.60	0.33	0.10
10/81	0.00	0.02	0.00
11/81	0.24	0.57	0.05
12/81	0.00	0.00	0.00
1981 $\bar{x}$	2.89	4.08	2.92
Overall	4.13[1]	2.89[2]	3.79[2]

1980 $\bar{x}$ = mean annual precipitation for 1980
1981 $\bar{x}$ = mean annual precipitation for 1981

1= 66 year precipitation average for the Barstow Climate Station

2= 47 year precipitation average for the Twentynine Palms and Iron Mountain weather stations.

Summary and Conclusions

The 1980 race course covered approximately 235 miles consisting of "178 miles of existing roads and trails, 42 miles of old race courses which have since been obliterated and 15 miles of areas devoid of existing roads and trails" according to the final EIS prepared for the race in September 1980. According to the draft enviromental assessment of June 1981, "the route, approximately 220 miles long, stays on obvious roads for 155 miles and makes use of cross country segments or areas where trails or random tracks occur for about 65 miles". With 70 to 75 per cent of the course on roads or existing trails where soils are currently compacted and generally void of vegetation the emphasis of the report is to determine what changes occur with intensive short term use. Considering the 1980 EIS, where 15 miles of the course was devoid of roads or trails and a maximum use width of 50 feet (25 feet from center line) the "new land" comprises 90.91 acres. With the average plot width (including pits 1 and 2) of 23.05 feet the 15 miles would comprise 41.91 acres. In areas where the trail narrowed, soil compaction as well as vegetative removal was intensified. In areas where the trail spread over 20 or more feet soil compaction measured by recording penetrometer was not increased more than one standard deviation unit above the adjacent areas void of any apparent vehicular traffic.

The climatic conditions between October 1980 and October 1982 resulted in below average precipitation with the exception of some thunderstorm activity during the summer of 1981.

Thunderstorms in the desert often result in extremely uneven precipitation patterns and usually are preceded and followed by rapid evaporative losses due to high temperatures and low relative humidities.

The majority of the course was on coarse textured soils on nearly level topography. A course usually following an existing wash area would not likely result in increased erosion. One portion of the course, along the north edge of Twentynine Palms Marine Base between Ludlow and Bagdad cut across natural washes and could actually reduce water erosion by creating a series of "mini-check-dams" that could enhance infiltration and reduce run off. Lack of rainfall did not allow any field measurement of run off.

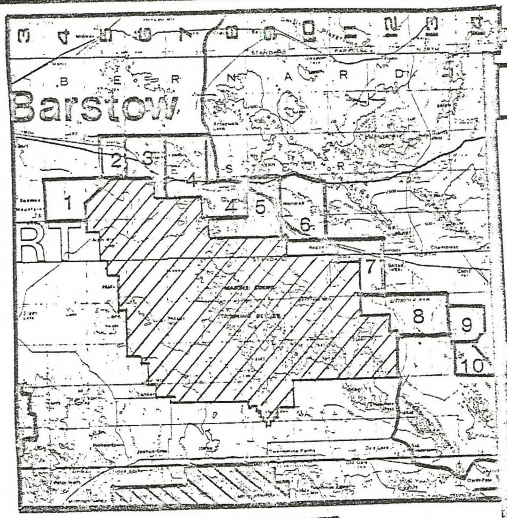
Vehicles moving off the assigned route north of the marine base (plot 7) in 1980 may have been the result of the event proceeding as a free-for all with only slight organization throughout the route. The 1981 event followed the proposed route more closely and seemed to remain entirely on (now) existing trails with the exception of some spreading in the pit areas.

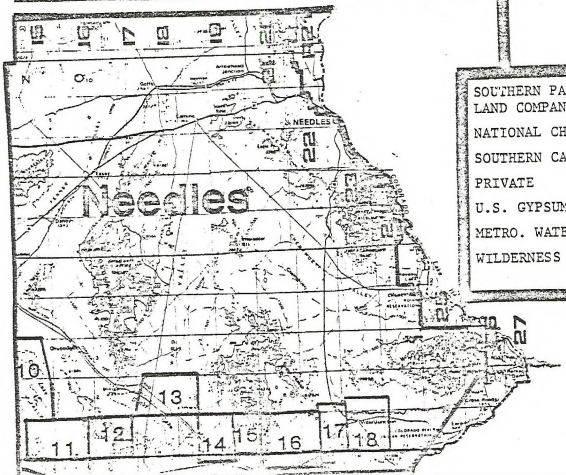
Long term repeated use of the course will likely result in maintained or increased compaction of soils on the trails and roads. The vegetative recovery beside the trails will likely appear as does the vegetation along major roads (including freeways). There is a narrow band of enriched vegetation along the sides of most existing roads as a result of the moisture accumulation allowing more intense vegetative cover. The same enriched zone will likely appear as a corridor if the current route is maintained by regular use.

APPENDIX I

Map of the Johnson Valley to Parker motorcycle race showing plot location of each of the selected study sites.

JOHNSON VALLEY TO PARKER MAP





LEGEND

OBVIOUS ROAD

CROSS COUNTRY

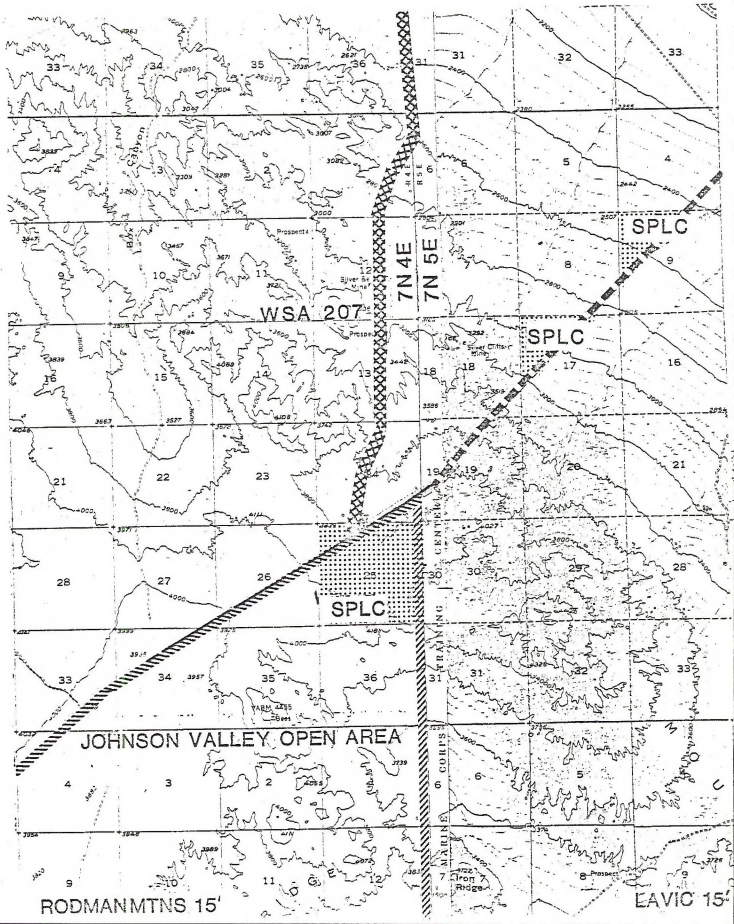
WILDERNESS BOUNDARY

JOHNSON VALLEY OPEN AREA

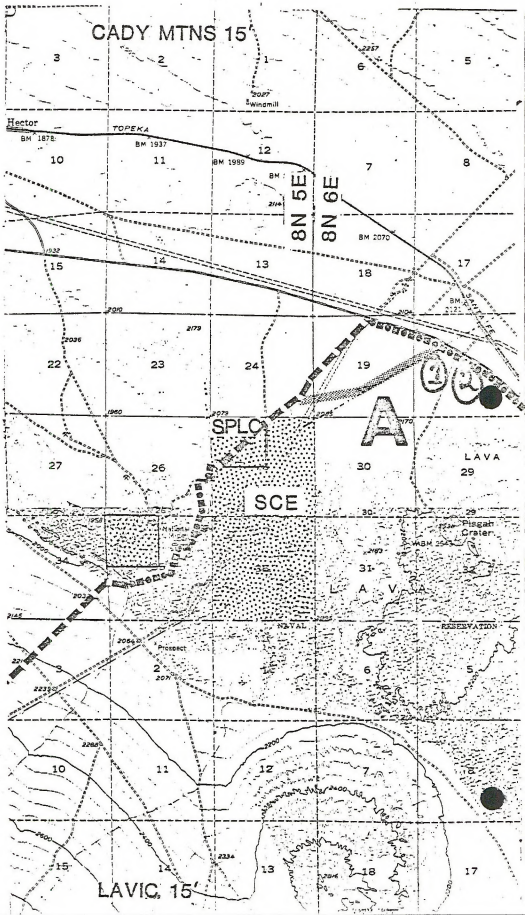
COURSE SEGMENTS PROPOSED FOR DELETION (1980)

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

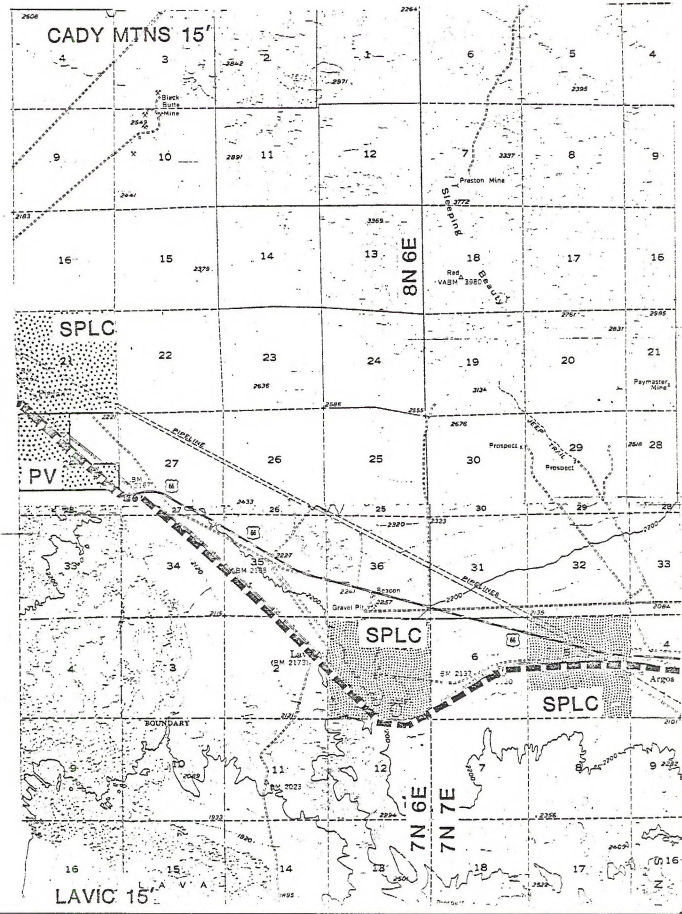
SOUTHERN PACIFIC LAND COMPANY	SPLC
NATIONAL CHLORIDE	NC
SOUTHERN CAL. EDISON	SCE
PRIVATE	PV
U.S. GYPSUM	USGY
METRO. WATER DIST.	MWD
WILDERNESS BOUNDARY	WSA


7N 4E
7N 5E
WSA 207
SPLC
SPLC
SPLC
JOHNSON VALLEY OPEN AREA
RODMAN MTNS 15'
EAVIC 15'

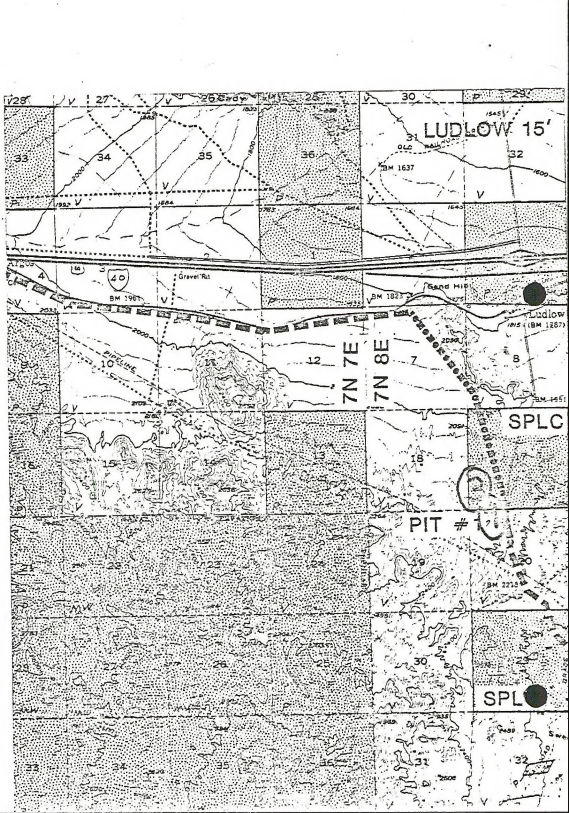
2

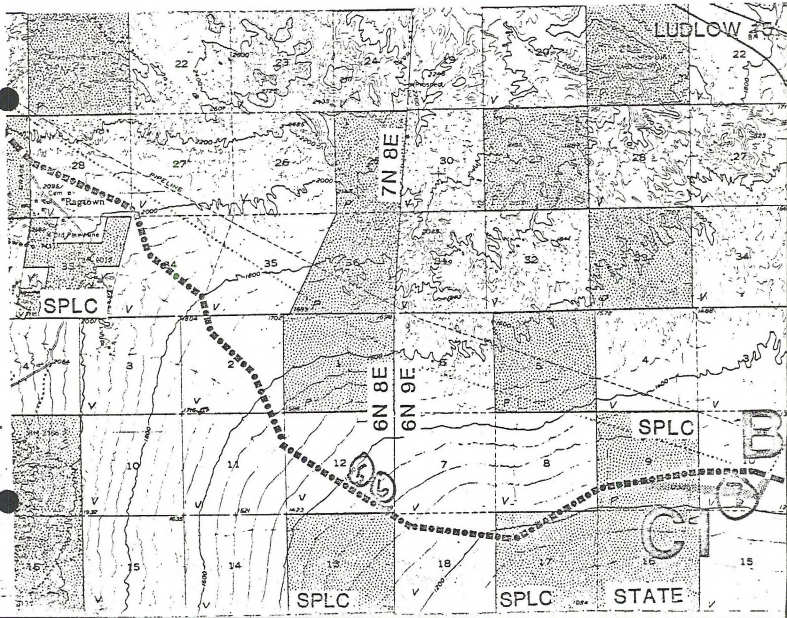

CADY MTNS 15'
Windmill
Hector
TOPEKA
BM 1878
BM 1937
BM 1989
BM 2070
8N 5E
8N 6E
SPLC
SCE
A
LAVA
Pisgah Crater
LAVA
NAVAL RESERVATION
LAVIC, 15'

3

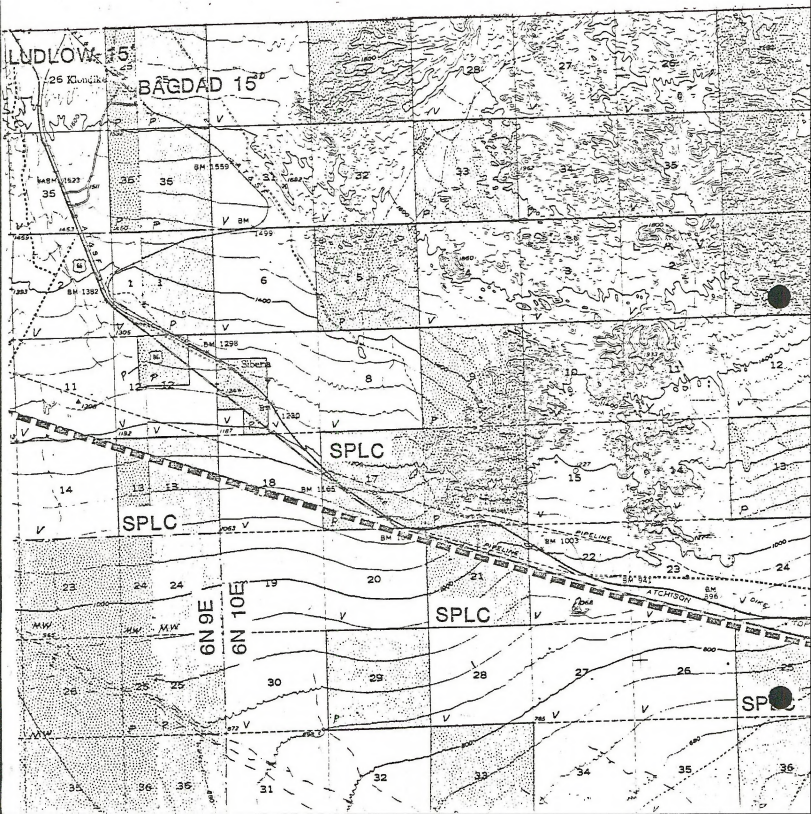

CADY MTNS 15'
Black Butte Mine
Preston Mine
Sidebottom Butte
Red Wash
8N 6E
SPLC
PV
PIPELINE
Prospect
Prospect
Paymaster Mine
Gravel Pit
Saxon
Lavic
Argos
SPLC
SPLC
BOUNDARY
7N 6E
7N 7E
LAVIC 15'

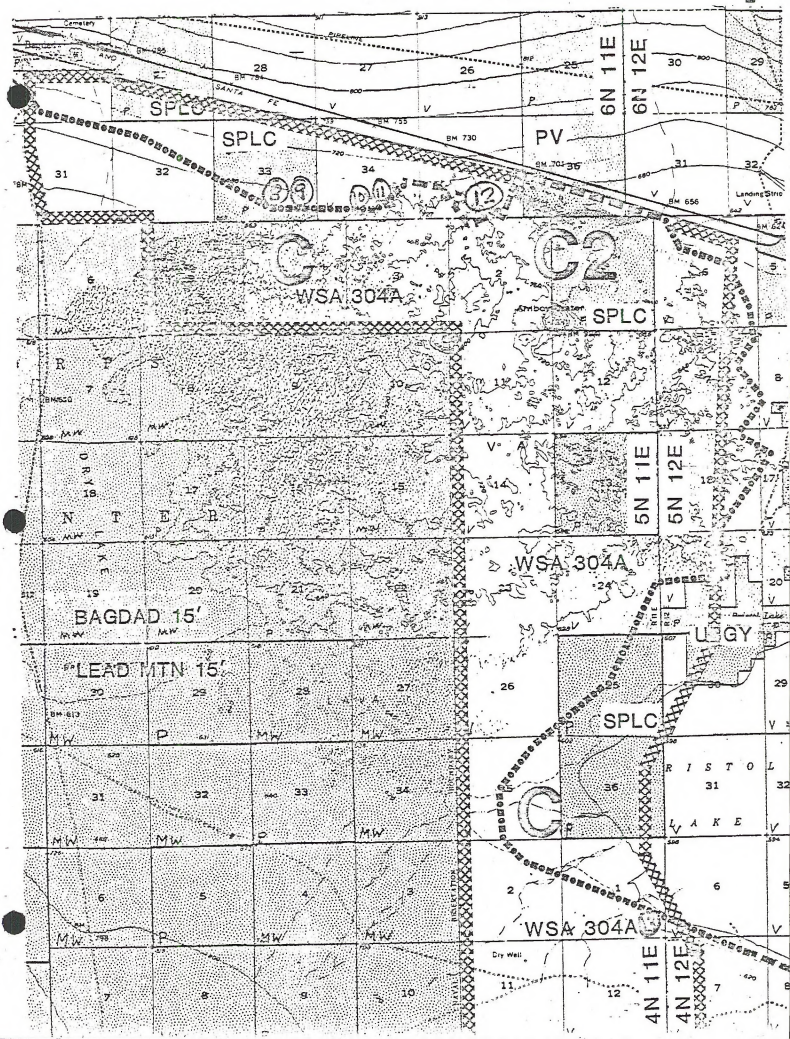
4

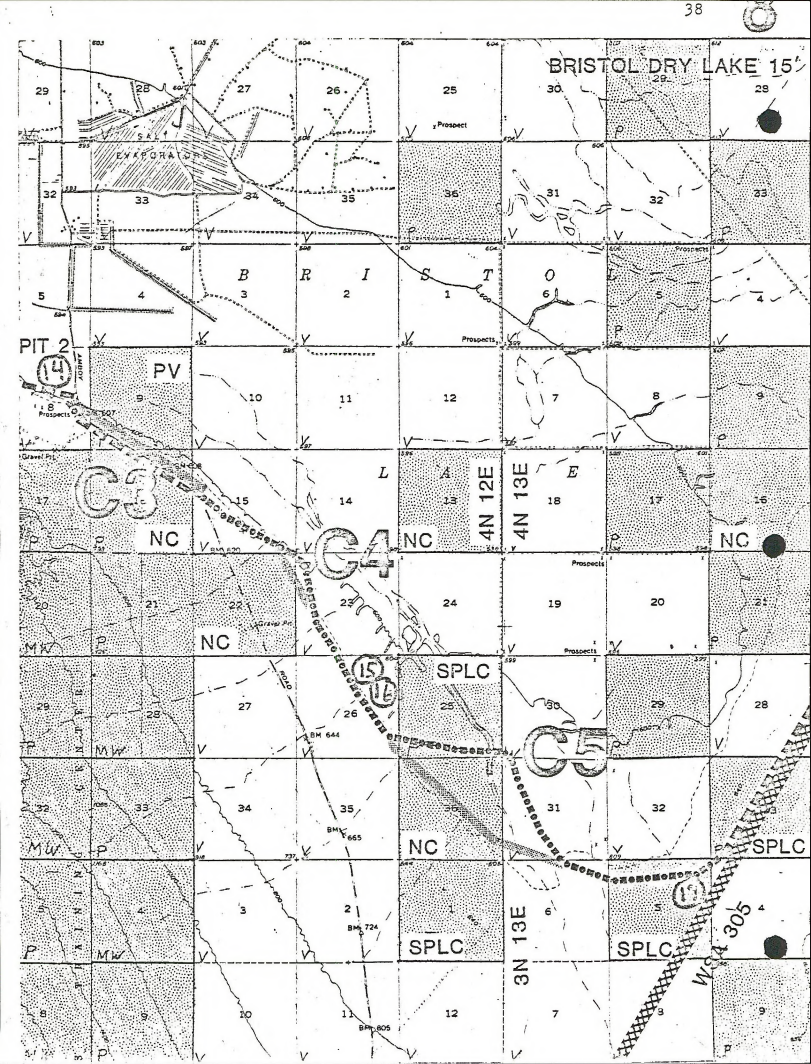


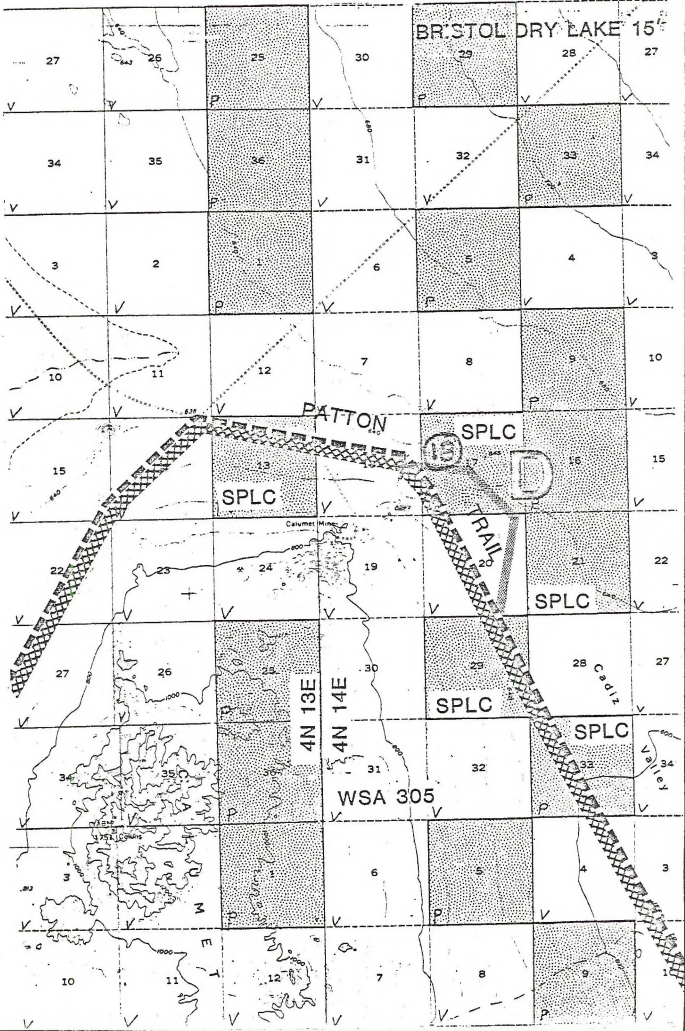

LUDLOW
7N 8E
6N 8E
6N 9E
SPLC
SPLC
SPLC
SPLC
STATE
Ragtown
Cem
Pipeline
B
B'
C
C'

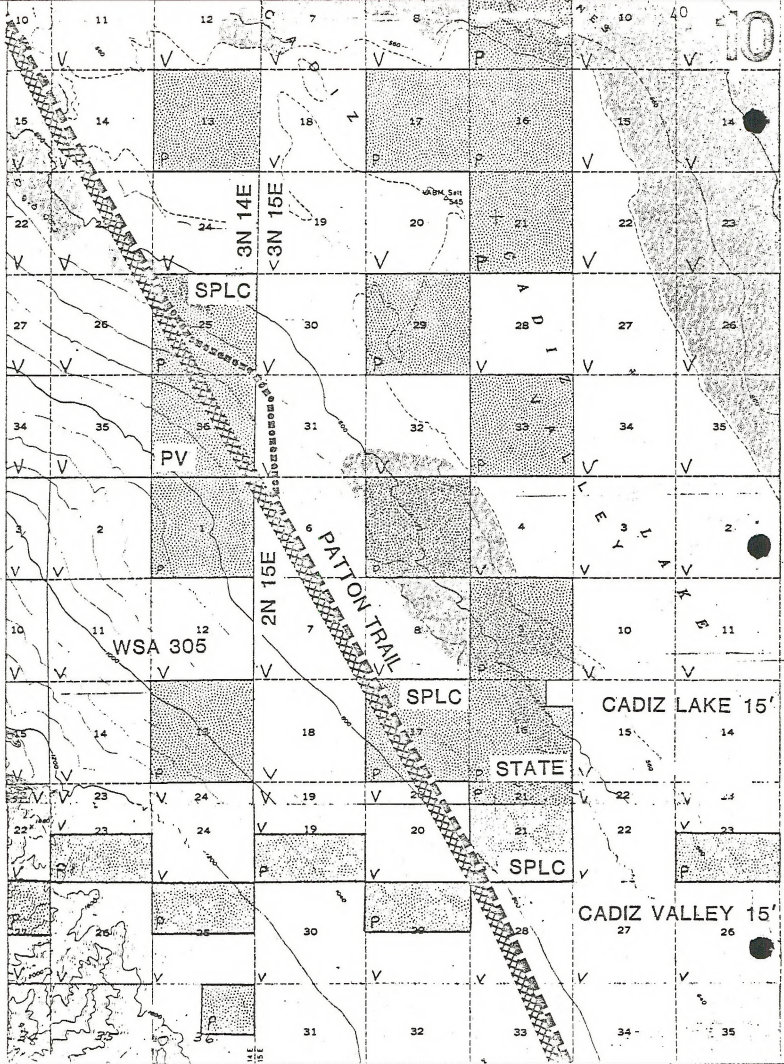
6

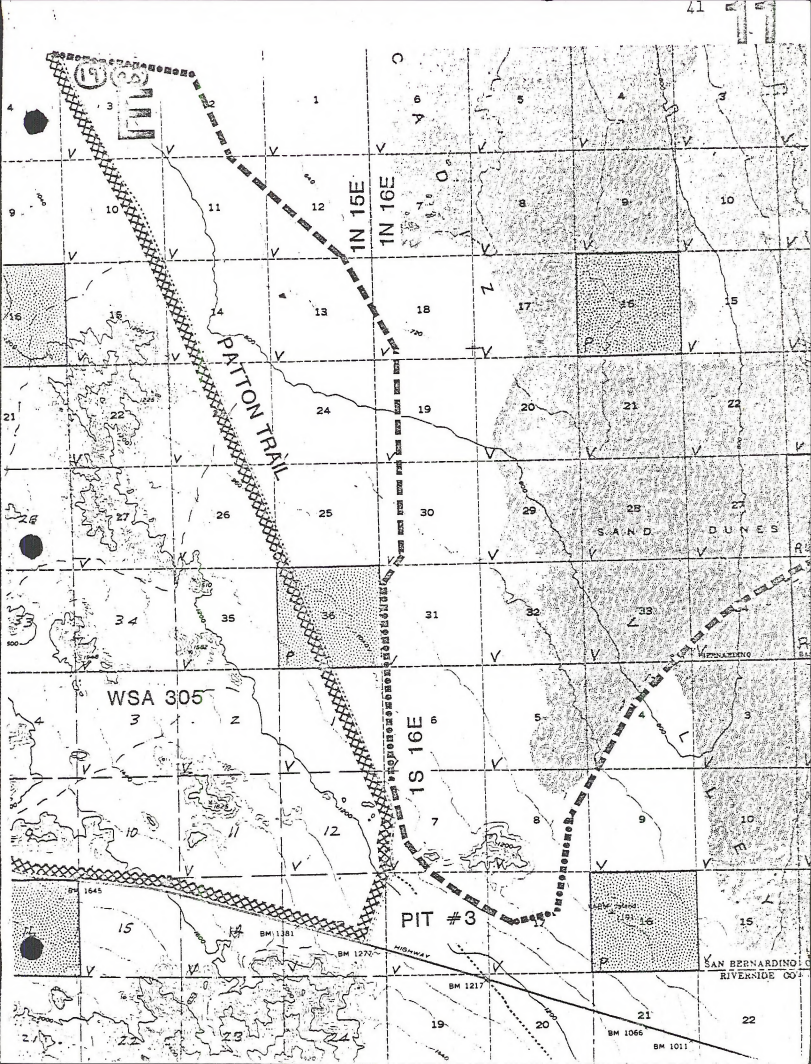

LUDLOW 15'
26 Klondike
BAGDAD 15'
SPLC
SPLC
SPLC
SPLC
6N 9E
6N 10E
PIPELINE
ATCHISON

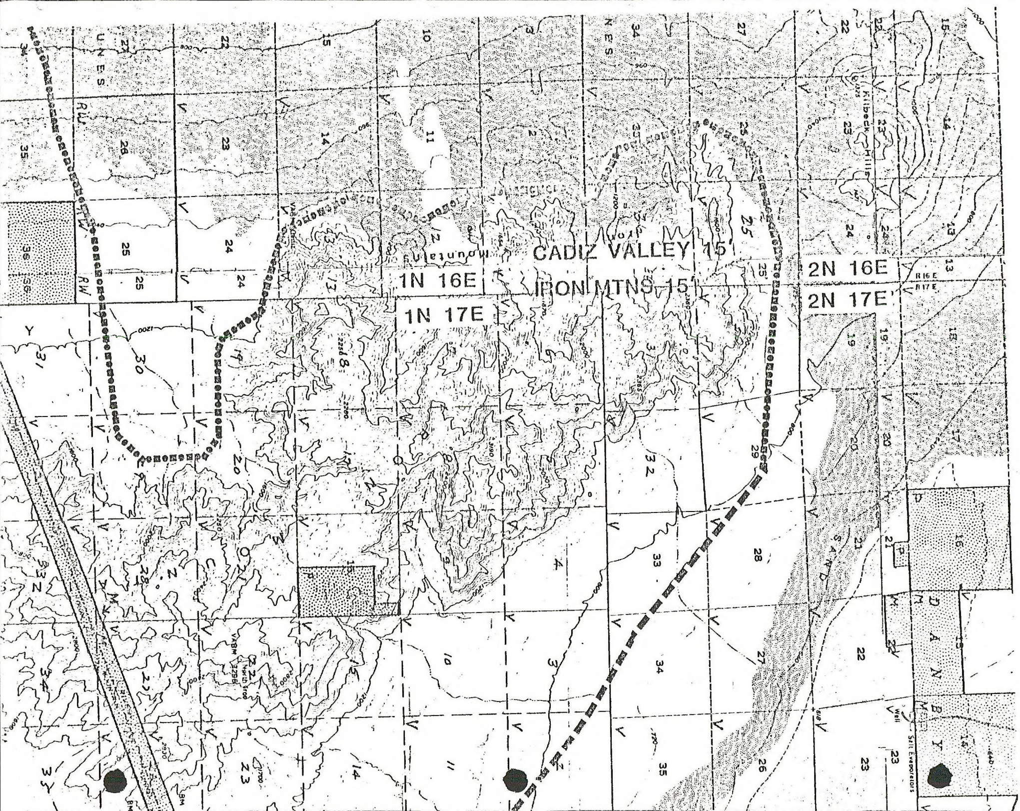

6N 11E
6N 12E
SPLC
SPLC
PV
BM 730
BM 701
BM 656
Landing Strip
WSA 304A
C2
SPLC
5N 11E
5N 12E
WSA 304A
BAGDAD 15'
LEAD MTN 15'
SPLC
LAKE
WSA 304A
4N 11E
4N 12E
Dry Well

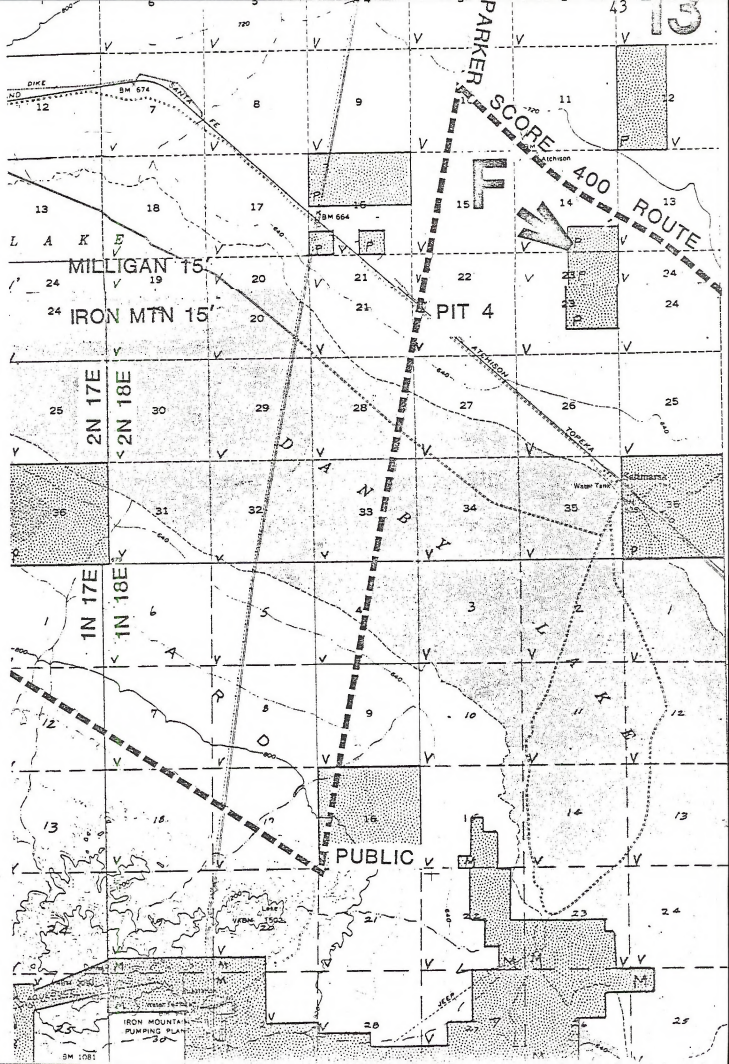

BRISTOL DRY LAKE 15'
SALT
EXPLORATORY
B R I S T O
L A K E
PIT 2
PV
NC
SPLC
C3
C4
C5
4N 12E
4N 13E
3N 13E
Prospects
Gravel Pit
BM 644
BM 665
BM 724
BM 805
US 395

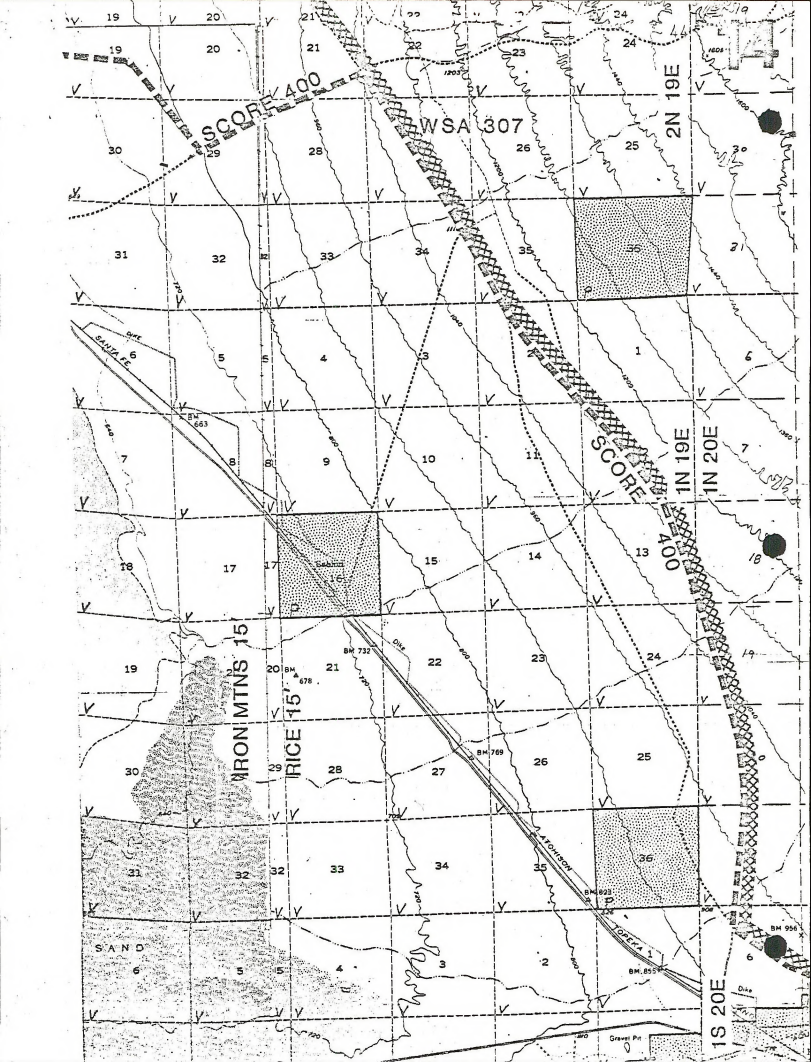

BRISTOL DRY LAKE 15
PATTON
SPLC
SPLC
TRAIL
SPLC
SPLC
SPLC
4N 13E
4N 14E
WSA 305
Cadiz
Valley
Calumet Mine

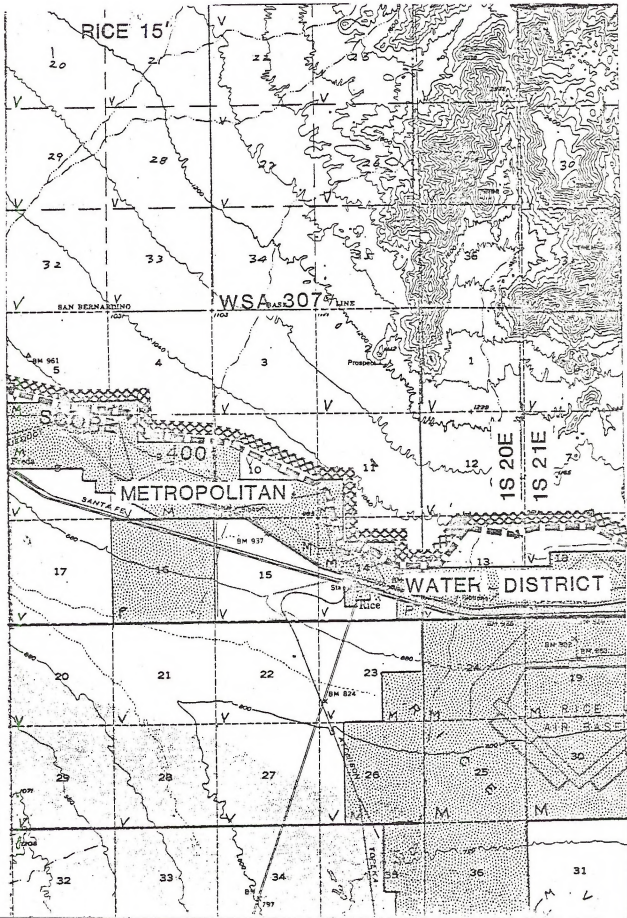

3N 14E
3N 15E
2N 15E
SPLC
PV
WSA 305
PATTON TRAIL
SPLC
SPLC
STATE
CADIZ LAKE 15'
CADIZ VALLEY 15'
CADIZ
LEVEE
LAKE


1N 16E
1S 16E
PATTON TRAIL
WSA 305
PIT #3
SAND DUNES
BM 1381
BM 1277
BM 1217
BM 1066
BM 1011
BM 1645
SAN BERNARDINO CO
RIVERSIDE CO


CADIZ VALLEY 15
IRON MTNS 15
1N 16E
1N 17E
2N 16E
2N 17E
R16E
R17E
Kilbeck Hills
Well
Salt Evaporators

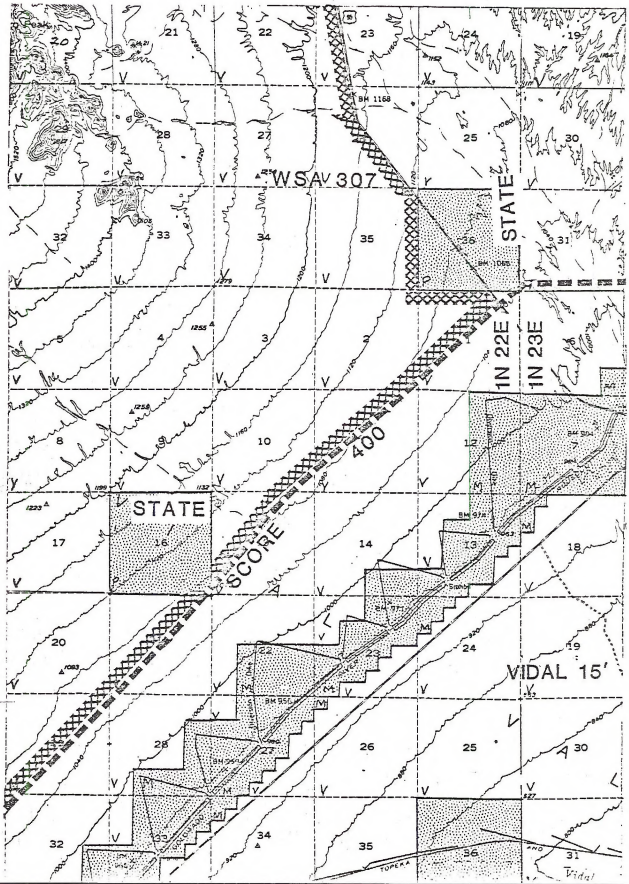

PARKER SCORE
400 ROUTE
MILLIGAN 15'
IRON MTN 15'
PIT 4
2N 17E
2N 18E
1N 17E
1N 18E
PUBLIC
IRON MOUNTAIN PUMPING PLANT
BM 674
BM 664
BM 1081
Water Tank
Schumann
Hatchison

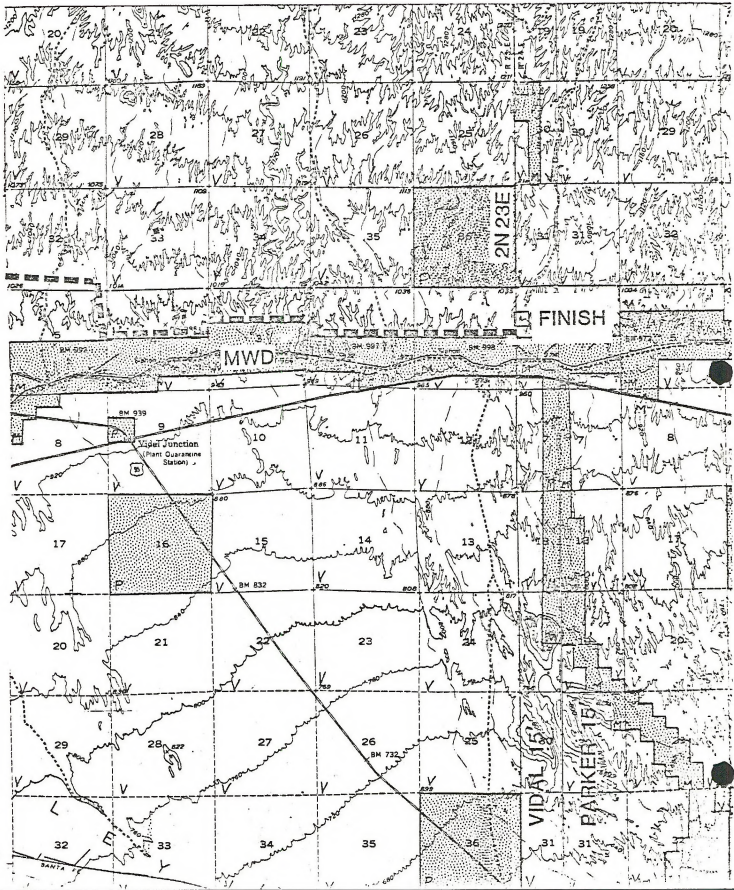

SCORE 400
WSA 307
2N 19E
1N 19E
1N 20E
SCORE 400
IRON MTNS 15'
IRICE 15'
SAND
1S 20E
SANTA FE
ATCHISON
TOPEKA &
BM 663
BM 678
BM 732
BM 769
BM 823
BM 855
BM 956
Gravel Pit


RICE 15'
WSA BASE LINE
SAN BERNARDINO
1S 20E
1S 21E
METROPOLITAN
WATER DISTRICT
SANTA FE
RICE
AIR BASE

WSA 307
1N 21E
1N 22E
1S 21E
1S 22E
SCORE
400
PV
MWD
SAN BERNARDINO CO
RIVERSIDE CO
RICE
15'
VIDAL
15'

17




2N 23E
FINISH
MWD
BM 922
BM 997
BM 939
Vidal Junction
(Plant Quarantine
Station)
BM 832
BM 732
VIDAL
PARKER 15
SANTA FE

Appendix II

Soil Survey of selected study sites along the Johnson Valley to Parker race course.

Site 1

Location: About 36 miles east of Barstow along Interstate Highway 40. NE¼, Sec. 20, T. 8N., R. 6E.

Classification: Fine-loamy, mixed, thermic Typic Haplargid. Probably in the Mohave series.

Vegetation: Widely scattered creosote bush and burrow weed. About 85 percent of surface is barren. Desert pavement covers 65 percent of the surface.

Parent material: Alluvium from mixed rocks, but mainly from granitic formations.

Physiography: Fan-remnant summit with a very large fan piedmont. Slope gradient is 1 percent. Elevation is about 2150 feet. Slow runoff; no runon; moderately slow permeability.

Pedon description: (Colors are for dry soil unless otherwise noted)

A 0 - 8 cm. Pinkish gray (7.5YR7/2) loamy sand, brown (7.5YR5/3) moist; weak medium platy structure; soft, very friable, nonsticky, nonplastic; common very fine roots; many very fine interstitial pores; violently effervescent; moderately alkaline (pH 8.0); abrupt wavy boundary. (6 to 10 cm. thick)

Bt 8 - 20 cm. Strong brown (7.5YR5/6) clay loam, brown (7.5YR4/4) moist; moderate fine and medium angular blocky structure; hard, firm sticky, plastic; many very fine roots; common very fine and fine tubular pores and common very fine interstitial pores; few faint clay films on faces of peds; violently effervescent; moderately alkaline (pH8.0); clear wavy boundary. (10 to 15 cm thick)

BCk 20 - 62 cm. Pink (7.5YR7/4) loam, brown (7.5YR5/4) moist; weak medium subangular blocky structure; slightly sticky, slightly plastic; few very fine roots; common fine tubular and interstitial pores; few faint clay films on faces of peds; violently effervescent; many fine and medium pinkish white (7.5YR8/2) lime filaments and soft lime masses; moderately alkaline (pH 8.4); clear wavy boundary. (36 to 45 cm thick)

2C 62 to 100 cm. Pinkish gray (7.5 YR7/2) gravelly loamy sand, light brown (7.5YR6/4) moist; massive; soft, very friable, nonsticky, nonplastic; common fine interstitial pores; strongly effervescent; moderately alkaline (pH 8.2).

Described by: J. A. Pomerening and R. J. Tullock, Oct. 2, 1982

Site 2

Location: About 36 miles east of Barstow along Interstate Highway 40. NE¼, Sec. 20, T. 8N, R. 6E. Two miles north of Pisgah Crater.

Classification: Mixed, thermic, Typic Torripsamment. Probably in the Cajon series.

Vegetation: Widely scattered creosote bush and big galleta grass. About 50 percent of the surface is barren.

Parent material: Eolian sands. This site is within a depression in a recent lava flow which has been filled to a depth of more than one meter by wind-blown sands. The site is about 50 feet east of the western margin of the lava flow.

Physiography: Moderately sloping depression in a lava flow. Slope gradient is 2 to 9 percent . Elevation is about 2170 feet. No runoff. May be considerable runon from surrounding lava. Rapid permeability.

Pedon description: (Colors are for dry soil unless otherwise notes.)

C1 0 - 12 cm. Pale brown (10 YR6/3) sand, brown (10YR5/3) moist; single grained; loose, nonsticky, nonplastic; many very fine roots; many very fine interstitial pores; strongly effervescent, disseminated lime; moderately alkaline (pH 8.0); clear smooth boundary. (6 to 15 cm thick)

C2 12 - 100 cm. Light yellowish brown (10YR6/4) sand, brown (7.5YR5/4) moist; single grained; loose, nonsticky, nonplastic; common very fine and fine roots; many fine interstitial pores; strongly effervescent, disseminated lime; moderately alkaline (pH 8.0).

Described by: J. A. Pomerening and R. J. Tullock, Oct. 2, 1982.

Sites 3 and 4

Location: About two miles south of Ludlow. NW¼, Sec 20, T. 7S, R. 6E.

Classification: Sandy-skeletal, mixed, thermic Typic orriorthents. Probably in the Arizo series. Could also be considered as Riverwash since the site is the floor of a broad channel.

Vegetation: Few scattered creosote bush. About 95 percent of the surface is barren. The surface is very gravelly and cobbly.

Parent material: Very gravelly sandy alluvium.

Physiography: An active channel about 30 feet wide and incised three feet or more into the sloping alluvial fan. Slope gradient is 5 percent. Elevation is about 2000 feet. Very rapid permeability. Runoff occurs when water flows in the channel during rain storms. Slope aspect is north.

Pedon description: (colors are for dry soil unless otherwise noted)

C1 0 - 10 cm Very pale brown (10YR7/4) very gravelly coarse sand, yellowish brown (10YR5/4) moist; single grained; loose, nonsticky, nonplastic, few fine roots; many very fine and fine interstitial pores; 50 percent pebbles; strongly effervescent; moderately alkaline (pH 8.2); clear wavy boundary. (5 to 15 cm thick).

C2 10 - 100 cm Very pale brown (10YR7/4) very gravelly coarse sand, brown (10YR5/4) moist; single-grained; loose, nonsticky, nonplastic; few very fine and fine roots; many very fine and fine interstitial pores; 65 percent pebbles; strongly effervescent; moderately alkaline (pH 8.2).

Described by: J. A. Pomerening and R. J. Tullock, Oct. 2, 1982.

Sites 5 and 6

Location: About 8 miles SE of Ludlow. SE¼, Sec. 12, T. 6 N, R 8E.

Classification: Sandy-skeletal, mixed, thermic, Typic Torriorthents. Probably in Arizo series.

Vegetation: a sparse growth of creosote bush, white bursage, and cholla.

Parent material: Very gravelly sandy alluvium.

Physiography: Fan piedmont with many intermittent shallow braided channels that are incised about 15 cm into the fan. Elevation is about 1350 feet. Slope gradient is about 2 percent. Very rapid permeability.

Pedon description: (Colors are for dry soil unless otherwise noted).

A 0 - 8 cm Light brownish gray (10YR6/2) very gravelly sand, dark grayish brown (10YR4/2) moist; single-grained; loose, nonsticky, nonplastic; common fine and medium roots; many very fine and fine interstitial pores; 50 percent pebbles; strongly effervescent; moderately alkaline (pH 8.2); clear wavy boundary. (2 to 10 mm thick)

C 8 - 100 cm Very pale brown (10YR7/4) very gravelly coarse sand, brown (10YR5/4) moist ; single-grained; loose, nonsticky, nonplastic; few very fine and fine roots; many very fine and fine interstitial pores; 60 percent pebbles; strongly effervescent; moderately alkaline (pH 8.2).

Described by: J. A. Pomerening and R. J. Tullock, Oct. 2 1982.

Site 7

Location: About 10 miles SE of Ludlow. SW¼, Sec 10, T6N, R9E.

Classification: On the basis of a color cambic horizon, and a significant enrichment of lime in the Bk horizon, the soil is tentatively classified as a sandyskeletal, mixed, thermic Typic Camborthid. The soil is on an older landform that of the soils of the Arizo series, and a younger landform than that of the Mohave series. There are no series correlated for this family.

Vegetation: Essentially barren. About 90% of the surface is covered with a desert pavement.

Parent material: Old gravelly and very gravelly sandy alluvium.

Physiography: A small fan-remnant summit elevated about 15 to 30 cm above the channels going around it. Elevation is about 1210 feet. Slope gradient is 2 to 3 percent.

Pedon description: (Colors are for dry soil unless otherwise noted)

A 0 - 7 cm Light brown (7.5YR6/4) gravelly fine sand, reddish brown (5YR4/3) moist; weak, medium subangular blocky structure; slightly hard, very friable, nonsticky, nonplastic; many medium .sicular pores and common very fine interstitial pores; 25 percent pebbles; violently effervescent; moderately alkaline (pH 8.0); clear wavy boundary. (3 to 10 cm thick)

Bw1 7 - 24 cm Light reddish brown (5YR6/4) gravelly sand, yellowish red (5YR4/6) moist, weak fine subangular blocky structure; slightly hard, very friable, nonsticky, nonplastic; few very fine roots; common fine and very fine interstitial pores; 25 percent pebbles; violently effervescent; moderately alkaline (pH 8.0); clear wavy boundary. (12 to 25 cm thick)

Bw2 24 - 40 cm Pinkish gray (7.5YR7/4) very gravelly sand, reddish brown (5YR4/4) moist; single-grained; loose, nonsticky, nonplastic; many very fine and fine interstitial pores; 35 percent pebbles; violently effervescent; moderately alkaline (pH 8.2); clear wavy boundary. (12 to 30 cm thick)

Bk 40 - 100 cm Pinkish gray (7.5YR7/4) very gravelly sand, brown (7.5YR5/4) moist; single-grained; loose, nonsticky, nonplastic; many very fine and fine interstitial pores; 45 percent pebbles; violently effervescent with many

40 cm thick)

C 84 - 100 cm Very pale brown (10YR7/3) very gravelly coarse sand, dark yellowish brown (10YR4/4) moist; single-grained; loose, nonsticky, nonplastic; many very fine and fine interstitial pores; strongly effervescent; moderately alkaline (pH 8.2).

Described by: J. A. Pomerening and R. J. Tullock, Oct. 23, 1982

Site 9

Location: About two miles south of Bagdad. SW¼, Sec 33, T6N, R11E. About 30 feet east of site 8.

Classification: Fine-loamy, mixed, thermic Typic Haplargid. Soils of the Mohave series are similar to this soil, although the shallow Bt horizon has more than 35 percent clay in this pedon.

Vegetation: Barren. The motorcycle trail disturbs this soil considerable the upper 8 cm is not gravelly, and the upper 20 to 25 cm is very powdery and "fluffy".

Parent material: Very gravelly alluvium of mixed lithology with a possible surficial mantel of eolian origin.

Physiography: Fan remnant summit about 15 to 30 cm above the floors of the channels which surround the remnant within a vast fan piedmont. Elevation is about 680 feet. Slope gradient is about 2 percent.

Pedon description: (Colors are for dry soil unless otherwise noted)

A 0 - 3 cm Light brown (7.5YR6/4) loam, dark brown (7.5YR4/4) moist; weak, thin platy structure; slightly hard very friable, slightly sticky, slightly plastic; many, medium vesicular pores; strongly effervescent; mildly alkaline (pH 7.6); clear wavy boundary. (2 to 8 cm thick)

Btl 3 - 10 cm Light brown (7.5YR6/4) clay loam, dark brown (7.5YR4/4) moist; moderate, medium columnar structure; slightly hard, friable, slightly sticky, plastic; few fine tabular pores between peds, and few fine tubular pores; 2 percent pebbles; strongly effervescent; mildly alkaline (pH 7.6); clear wavy boundary (5 to 15 cm thick).

Bt2 10 - 23 cm Reddish yellow (5Yr6/6) gravelly clay, yellowish red (5YR4/6) moist; weak fine subangular blocky structure; soft, very friable, sticky, plastic; many fine and very fine interstitial pores; 20 percent pebbles; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary. (10 to 20 cm thick)

2Bk 23 - 80 cm Light brown (7.5YR6/4) very gravelly sandy loam, brown (7.5YR4/4) moist, massive; slightly hard, very friable, slightly sticky, slightly plastic; common very fine interstitial pores; 45 percent pebbles; violently effervescent; common medium soft masses of white lime; moderately alkaline (pH 8.0),

distinct white lime coatings on all sides of the pebbles; moderately alkaline (pH 8.0).

Described by: J. A. Pomerening and R. J. Tullock, Oct. 2, 1982.

Site 8

Location: About two miles south of Bagdad. SW¼, Sec 33, T. 6N, R. 11E.

Classification: Sandy-skeletal, mixed, thermic Arenic Haplargid. Blackmount soils are in this family, but are finer than very gravelly loamy sand in the Bt horizon.

Vegetation: Scattered creosote bush and white bursage. Eighty percent of the surface is barren.

Parent material: Very gravelly alluvium from mixed volvanic and granitic lithology.

Physiography: In a shallow channel of a vast fan piedmont. Elevation is about 680 feet. Slope gradient is 2 - 3 percent. Aspect is south. Vegetation grows in the washes, but the adjacent fan-remnant summits are essentially barren.

Pedon description: (Colors are for dry soil unless otherwise noted)

A1 0 - 12 cm Very pale brown (10YR7/3) very gravelly sand, brown (10YR4/3) moist; single-grained, loose, nonsticky, nonplastic; many very fine and fine roots; many very fine and fine interstitial pores; 50 percent pebbles; strongly effervescent; moderately alkaline (pH 8.2), clear wavy boundary. (6 to 18 cm thick)

A2 12 - 28 cm Very pale brown (10YR7/3) very gravelly sand, dark yellowish brown (10YR4/4) moist; single-grained; loose, nonsticky, nonplastic; common very fine roots; many very fine and fine interstitial pores; 50 percent pebbles; strongly effervescent; moderately alkaline (pH 8.2); clears wavy boundary. (10 to 20 cm thick)

Bt 28 - 54 cm Light brown (7.5YR6/4)very gravelly loamy sand, brown (7.5YR4/4) moist; massive; very hard, friable, slightly sticky, slightly plastic; few very fine roots; common very fine interstitial and tubular pores; common faint clay bridging between sand grains; 35 percent pebbles; slightly effervescent; mildly alkaline (pH 7.8); clear wavy boundary. (20 to 30 cm thick)

Bk 54 - 84 cm Pinkish gray (7.5YR7/2) very gravelly sandy loam; brown (7.5YR4/4) moist; weak medium platy structure; hard friable, slightly sticky, slightly plastic; common very fine interstitial and tubular pores; 40 percent pebbles; violently effervescent; common distinct white coatings of lime on tubular pores and on pebbles; moderately alkaline (pH 8.3), clear wavy boundary. (20 to

cleary wavy boundary. (50 to 75 cm thick)

2C 80 - 100 cm Light brown (7.5YR6/4) very gravelly loamy sand, brown (7.5YR4/4) moist; single-grained; loose, nonsticky, nonplastic; many very fine and fine interstitial pores; 50 percent pebbles; strongly effervescent; moderately alkaline (pH 8.0).

Described by: J. A. Pomerening and R. J. Tullock, Oct. 23,1982.

Sites 10 and 11

Location: About 200 feet north of lava flow from Amboy Crater in SW¼, Sec 34, T6N, R11E.

Classification: Coarse-loamy, mixed thermic Typic Camborthid. There are no series from California in this family. The clay content of the control section is 15 to 18 percent. The Adelino soils from New Mexico are fine-loamy, mixed thermic Typic Camborthids. The Dateland soils from Arizona are coarse-loamy, mixed, hyperthermic Typic Camborthids. If the cambic horizon in this soil was absent it would be similar to the Indio soils which are coarse-silty mixed (calcareous), hyperthermic Typic Torrifluvents.

Vegetation: Mostly barren with a few scattered creostoe bush.

Parent material: Nongravelly aluvium mostly of very fine sand and silt sizes. The upper 30 cm may be lacustrine-like sediments deposited in a basin which was formed when the lava flow formed a dam across the natural surface drainage towards Bristol Lake. The upper two centimeters have been reworked by wind.

Physiography: A basin at the lower margin of an alluvial fan between a sloping fan and a playA. Slope gradient is 0. Elevation is about 690 feet. The area may be ponded briefly during flash floods.

Pedon description: (Colors are for dry soil unless otherwise noted)

A 0 - 8 cm Very pale brown (10YR7/3) loam, brown (10YR4/3) moist; weak, medium subangular block structure; slightly hard, friable, slightly sticky, slightly plastic; few very fine roots; many medium vesicular pores, and common fine interstitial pores; violently effervescent moderately alkaline (pH 8.2); clear wavy boundary. (4 to 15 cm thick)

Bw 8 - 32 cm Light brown (7.5YR6/4) clay loam, dark brown (7.5YR4/4) moist; moderate, medium suangular blocky structure; hard, firm, slightly sticky, plastic; common very fine roots; many fine and very fine interstitial pores and common fine tubular pores; violently effervescent; moderately alkaline (pH 8.2); clear wavy boundary. (16 to 30 cm thick)

C 32 - 100 cm Very pale brown (10YR7/3) very fine sandy loam; dark yellowish brown (10YR4/4) moist; massive; soft, very friable, slightly sticky, slightly plastic; few very fine roots, many very fine interstitial and tubular pores; violently effervescent, few distinct white lime filaments in tubular pores; moderately alkaline (pH 8.2).

Described by: J. A. Pomerening and R. J. Tullock, Oct. 2, 1982.

Site 12

Location: At the edge of the lava flow from Amboy Crater in SE¼, Sec. 35, T6N, R11E.

Classification: Mixed, thermic, Typic Torripsamment. Cajon series.

Vegetation: Scattered creosote bush and big galleta grass.

Parent material: Eolian sands.

Physiography: Gently sloping dune against a lava flow. Elevation is about 700 feet. Slope gradient is about 8 percent to the north.

Pedon Description: (Colors are for dry soil unless otherwise noted)

C1 0 - 22 cm Very pale brown (10YR7/3) loamy sand, brown (7.5YR5/4) moist; massive; slightly hard, very friable, slightly sticky, nonplastic; common very fine and fine roots; many very fine and fine interstitial pores; mildly effervescent; mildly alkaline (pH 7.8); clear wavy boundary. (15 to 30 cm thick)

C2 22- 44 cm Very pale brown (10YR7/3) loamy sand, dark brown (7.5YR4/4) moist; massive; slightly hard, very friable, slightly sticky, nonplastic; many very fine and fine roots; many very fine and fine interstitial pores, violently effervescent; moderately alkaline (pH 8.2); clear wavy boundary. (16 to 30 cm thick)

C3 44 - 100 cm Light brown (7.5YR6/4) sand; dark brown (7.5YR4/4) moist; single-grained; loose, nonsticky, nonplastic; few very fine roots; many fine interstitial pores; violently effervescent; moderately alkaline (pH 8.2).

Described by: J. A. Pomerening and R. J. Tullock, Oct. 2, 1982.

Site 13

Location: Along south side of Bristol Lake in SE¼, Sec. 1, T4N, R11E.

Classification: Sandy over loamy, mixed, thermic Typic Torriorthent. This soil is similar to the saline phase of the Cajon series in the upper 60 cm. The substratum below 60 cm is a silt loam with less than 18 percent clay. The yellowrock soils are sandy, mixed, thermic Typic Torriorthents and are gravelly loamy sands throughout their sola. Indio soils are coarse-silty, mixed (calcareous), hyperthermic Typic Torrifluvents. If this soil were coarse-silty between 25 and 100 cm it would be in that series if it were hyperthermic.

Vegetation: Mojave seablight, shadscale and creosote bush.

Parent material: Sandy alluvium over lacustrine silts. The sands have been reworked by wind in the upper part.

Physiography: The margin of an alluvial fan with a playa (Bristol Lake). Elevation is about 600 feet. Slope is 1 percent. The soil is moderately well to somewhat poorly drained.

Pedon description: Colors are for dry soil unless otherwise noted)

C1 0 -15 cm Very pale brown (10YR7/3) sand, dark brown (10YR4/3) moist; weak thin platy structure in upper 6 cm and single-grained below that; loose; nonsticky, nonplastic; common fine and medium roots; many fine interstitial pores; mildly effervescent; moderately alkaline (pH 8.0); clear wavy boundary. (8 - 20 cm thick)

C2 15 - 60 cm Pale brown (10YR6/3) loamy fine sand, dark brown (10YR4/3) moist; massive; soft, very friable, nonsticky, nonplastic; few very fine roots; many very fine interstitial pores; strongly effervescent; moderately alkaline (pH 8.4); abrupt wavy boundary. (40 - 55 cm thick)

2C3 60 - 120 cm Pale brown (10YR6/3) silt loam, dark brown (10YR4/3) moist with common medium distinct olive brown (2.5Y4/4) mottles; massive; soft, very friable, slightly sticky, slightly plastic; few very fine roots; common fine tubular and interstitial pores; strongly effervescent; moderately alkaline (pH 8.4).

Described by: J. A. Pomerening and R. J. Tullock, Oct. 23, 1982.

Site 14

Location: On south margin of Bristol Lake about 200 yards west of the road between Amboy and 29 Palms in NE¼, Sec. 8, T4N, R12E.

Classification: Mixed, thermic Typic Torripsamment. Saline phase of the Cajon series.

Vegetation: Shadscale, creosote bush and Mojave seablight.

Parent material: Sandy alluvium mainly from granitic rocks.

Physiography: Lower portion of a alluvial fan along the edge of Bristol Lake. Elevation is about 600 feet. Slope gradient is 1 percent.

Pedon description: (Colors are for dry soil unless otherwise noted)

A 0 - 4 cm Very pale brown (10YR7/3) sand, brown (10YR4/3) moist; weak thin platy structure; slightly hard, very friable, nonsticky, nonplastic; common very fine roots; many medium vesicular pores; strongly efferescent; moderately alkaline (pH 8.2); abrupt wavy boundary. (3 to 8 cm thick)

C1 4 - 12 cm Very pale brown (10YR7/3) gravelly sand, brown (10YR5/3) moist; massive; slightly hard, very friable, nonsticky, nonplastic; many fine and medium roots; many very fine and fine interstitial pores; 25 percent pebbles; mildly effervescent; moderately alkaline (pH 8.2); clear wavy boundary. (6 to 15 cm thick)

C2 12 - 50 cm Very pale borwn (10YR7/3) gravelly sand, brown (10YR5/3) moist; single-grained; loose, nonsticky, nonplastic; common fine roots; many very fine and fine interstitial pores; 30 percent pebbles; mildly effervescent; moderately alkaline (pH 8.2), gradual smooth boundary. (30 to 45 cm thick)

C3 50 - 100 cm Very pale brown (10YR7/3) sand, brown (10YR5/3) moist; single-grained; loose, nonsticky, nonplastic; few fine roots; many very fine and fine interstitial pores; 10 percent pebbles; mildly effervescent; moderately alkaline (pH 8.2).

Described by: J. A. Pomerening and R. J. Tullock, Oct. 23, 1982.

Sites 15 and 16

Location: Southeast of Bristol Lake in NE¼, Sec 26, T4N, R12E.

Classification: Fine-loamy, mixed, thermic Typic Haplargid. Probably in the Mohave series.

Vegetation: Scattered creosote bush and white bursage.

Parent material: Sandy alluvium mainly from granitic rocks.

Physiography: Fan-remnant summit. Elevation is about 640 feet. Slope gradient is 1 to 2 percent.

Pedon description: (Colors are for dry soil unless otherwise noted).

A 0-6 cm Light gray (10YR7/2) fine sand, brown (10YR5/3) moist; single-grained; loose, nonsticky, nonplastic; common very fine and fine roots; many very fine interstitial pores; strongly effervescent; mildly alkaline (pH 7.8); abrupt wavy boundary. (4 to 10 cm thick)

Bt 6-15 cm Light brown (7.5YR6/4) clay loam, brown (7.5YR4/4) moist; moderate, medium subangular blocky structure; slightly hard, very friable, sticky, plastic; many very fine roots; common very fine and fine tubular pores and common very fine interstitial pores; few distinct clay films in pores and as bridges; slightly effervescent; moderately alkaline (pH 8.0); clear wavy boundary. (6 to 15 cm thick).

Ck 15 - 44 cm Pale brown (10YR6/3) gravelly sand, dark brown (10YR4/3) moist; single-grained; loose, nonsticky, nonplastic; common very fine roots; many very fine and fine interstitial pores; 20 percent pebbles; strongly effervescent; common fine pink (7.5YR7/4) lime filaments and soft masses; moderately alkaline (pH 8.2); abrupt smooth boundary (25 to 35 cm thick)

C 44 - 100 cm Light gray (2.5Y7/2) loamy fine sand, dark grayish brown (2.5Y4/2) moist; massive; slightly hard, very friable, slightly sticky, slightly plastic; few coarse prominant reddish brown (5YR4/4) mottles; few very fine roots; many very fine interstitial pores, strongly effervescent, common fine pink (7.5YR7/4) soft lime masses; moderately alkaline (pH 8.2)

Described by: J. A. Pomerening and R. J. Tullock, Oct. 23, 1982.

Site 17

Location: East side of Bristol Lake in NE¼, Sec 5, T6N, R13E. Along telephone line road.

Classification: Mixed, thermic Typic Torripsamment. Cajon series.

Vegetation: Widely scattered creosote bush generally less than three feet tall.

Parent material: Sandy alluvium mainly from granitic rocks. The area is stony with boulders about 50 feet apart.

Physiography: On the interfluvial portion of a dissected alluvial fan where the channels are incised about two feet. Elevation is about 640 feet. Slope gradient is 3 percent. Slope aspect is west.

Pedon description: (colors are for dry soil unless otherwise noted).

C1 0 - 24 cm Very pale brown (10YR7/3) gravelly sand, yellowish brown (10YR5/4) moist; single-grained; loose, nonsticky, nonplastic; common very fine and fine roots; many very fine and fine interstitial pores; 20 percent pebbles; slightly effervescent; moderately alkaline (pH 8.0), clear wavy boundary (20 to 30 cm thick).

C2 24 - 100 cm Very pale brown (10YR7/3) fine sand, yellowish brown (10YR5/4) moist; single-grained; loose, nonsticky, nonplastic; few very fine roots; many very fine interstitial pores; 5 percent pebbles; slightly effervescent; mildly alkaline (pH 7.7).

Described by: J. A. Pomerening and R. J. Tullock, Oct. 23, 1982.

Site 18

Location: East of Bristol Lake in SW¼, Sec. 17, T4N, R14E.

Classification: Fine-loamy, mixed, thermic Typic Haplargid. Probably in the Mohave series.

Vegetation: Scattered creosote bush and white bursage.

Parent material: Old sandy alluvium mainly from granitic rocks.

Physiography: On a stable alluvial fan piedmont that is not dissected with recent channels. Elevation is 640 feet. Slope gradient is 1 percent.

Pedon description: (Colors are for dry soil unless otherwise noted).

A 0 - 7 cm Very pale brown (10YR7/3) gravelly sand, yellowish brown (10YR5/4)moist; massive; slightly hard, very friable, nonsticky, nonplastic; common very fine roots; many medium vesicular pores and common fine interstitial pores; 20 percent pebbles; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary (4 - 15 cm thick).

Bt 7 - 27 cm Yellowish red (5YR5/6) gravelly clay loam, yellowish red (5YR4/6) moist, moderate, medium subangular blocky structure; hard, friable, sticky, plastic; many very fine and fine roots; common fine tubular pores, and common very fine interstitial pores; common distinct clay films on ped faces; 25 percent pebbles; strongly effervescent; moderately alkaline (pH 8.2); clear wavy boundary. (15 to 25 cm thick)

BC 27 - 50 cm Strong brown (7.5YR5/6) sandy loam, brown (7.5YR4/4) moist; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky, nonplastic; common very fine roots; common very fine interstitial pores; few distinct clay films lining pores and on ped faces; 2 percent pebbles; strongly effervescent; moderately alkaline (pH 8.4); clear wavy boundary (20 - 30 cm thick).

C 50 - 100 cm Light brown (7.5YR6/4) loamy sand, brown (7.5YR5/4) moist; massive; soft, very friable, nonsticky nonplastic; few very fine roots; many very fine interstitial pores; strongly effervescent; moderately alkaline (pH 8.4)

Described by: J. A. Pomerening and R. J. Tullock, Oct. 23,1982.

Sites 19 and 20

Location: Along Patton Tank Road in NW¼, Sec. 3, T1N, R15E.

Classification: Mixed, thermic Typic Torripsamment. Cajon series.

Vegetation: Scattered creostoe bush and white bursage.

Parent material: Sandy alluvium mainly from granitic rocks.

Physiography: Fan piedmont. Elevation is about 800 feet. Slope gradient is 3 percent.

Pedon description: Colors are for dry soil unless otherwise noted).

A 0 - 5 cm Pink (7.5YR7/4) coarse sand, brown (7.5YR5/4) moist; single-grained; loose, nonsticky, nonplastic; common very fine roots; many very fine and fine interstitial pores; 5 percent pebbles; strongly effervescent; moderately alkaline (pH 8.0); clear wavy boundary. (3 to 8 cm thick).

C1 5 - 50 cm Light brown (7.5YR6/4) coarse sand; brown (7.5YR4/4) moist; single-grained; loose, nonsticky, nonplastic; common fine roots; many very fine and fine interstitial pores; 10 percent pebbles; strongly effervescent; moderately alkaline (pH 8.2); clear wavy boundary. (40 to 60 cm thick)

C2 50 - 100 cm Pinkish gray (7.5YR7/2) coarse sand, brown (7.5YR5/4) moist; single-grained; loose nonsticky, nonplastic; few fine roots; many very fine and fine interstitial pores; 10 percent pebbles; strongly effervescent; moderately alkaline (pH 8.0).

Described by: J. A. Pomerening and R. J. Tullock, Oct. 23, 1982

APPENDIX III

Guide for Rating Soil Limitations for Wheeled Off-Road Recreational Vehicles

(Proposed by Committee 3, WRTSSWPC, February, 1982)

Wheeled off-road vehicles include motorcycles, minibikes, trail bikes, dune buggies, and all-terrain vehicles. They do not include snowmobiles. The off-road vehicles are used primarily for recreation and either follow self-established trails or cross the terrain in a random manner. Off-road vehicles can lower the natural productivity of the soils by increasing the amount of erosion and by compacting the soil. Therefore, the soil limitation ratings are based on the water erosion hazard, the wind erosion hazard, and the strength or bearing capacity of the soil. The water erosion hazard rating is based on the soil erodibility (K) factor, the slope gradient (S) factor, and the rainfall (R) factor of the universal soil loss equation (USLE). The vegetative cover (C) factor is given a value of 1.0 because the continued use of an area by the vehicles generally results in the formation of unvegetated trails in which the surface layer of the soils is disturbed. The wind erosion hazard rating is based on the standard wind erosion groups. The wind erosion hazard is only applied when the uppermost layer of the soil is dry and the velocity of the wind is equal to, or greater than, The threshold velocity for sand grains of 0.1 mm in diameter. The soil strength, or bearing capacity, rating is based on the unified engineering soil classification groups.

The soil limitation ratings do not consider soil properties or qualities affecting the safety or health of the operator or potential damage to the vehicle. Nor do they consider other factors which may limit use, such as the status of the vegetation,

wildlife, cultural and historic resources, access, and size and shape of the area.

Soils with a slight limitation rating will generally not suffer an irreparable reduction in their natural productivity level by the long-term, intensive use of wheeled off-road vehicles. Soils with a moderate limitation rating will suffer a significant reduction in their natural productivity level by the long-term, intensive use of wheeled off-road vehicles, but can be managed for sustained natural productivity by controlling the timing and intensity of use, and their natural productivity level can be restored through the application of relatively simple soil compaction amelioration treatments. Soils with a severe limitation generally will suffer an irreparable reduction in their natural procuctivity level even by the limited use of off-raod vehicles.

Table 1. Guide for Rating Soil Limitations for Wheeled Off-Road Vehicles (Proposed by Committee 3, Western Regional Soil Survey Work Planning Conference, February, 1982)

Soil Property or Quality	Limits			Restrictive Feature
	Slight	Moderate	Severe	
1. Water Erosion Hazard				
A'=(KSR) for T of:				Erodes easily
a. 1 t/ac/yr	<1	1-2	>2	
b. 2 t/ac/yr	<2	2-4	>4	
c. 3 t/ac/yr	<3	3-6	>6	
d. 4 t/ac/yr	<4	4-8	>8	
e. 5 t/ac/yr	<5	5-10	>10	
2. Wind Erosion Hazard[1]				
Wind erosion group of surface layer	6,7,8	3,4,4L,5	1,2	Soil blowing
3. Soil Strength				
Unified class	GW,GP,GM,GW-GM, GW-GC,GP-GM	GC,SW,SP,SM,SC, GM-BC,GP-GC, SM-SC,SW-SM,SW-SC, SP-SM,SP-SC	ML,CL,OL,MH,CH, OH,CL-ML,PT	Low strength

[1]Applicable only at time periods when the surface of the soil is dry and the wind velocity is greater than 8 miles per hour at 6 inches above the ground, or 13 miles per hour at 1 foot above the ground.

The rating guide was developed for random use by ORV's. It is realized that the factors were developed for a cultivated agricultural enterprise. Intensive ORV use removes vegetation and disrupts the soil surface less than or equal to; never to exceed the level of vegetative removal or soil disruption of cultivation, and therefore is an excellent first approximation.

To properly use the guide, Table 2 is used to determine allowable soil losses (in tons per acre) for soils of medial slopes from one to sixty percent for a given rainfall factor.

Table 2. A' values by percent slope and K-factor values for an R-factor value of 25[1]

s(%)	S	A'=KSR for K of										
		0.1	0.15	0.17	0.20	0.24	0.28	0.32	0.37	0.43	0.49	0.55	0.64
1	0.116	0.29	0.44	0.49	0.58	0.70	0.81	0.93	1.07	1.25	1.42	1.56	1.86
2	0.181	0.45	0.68	0.77	0.90	1.09	1.27	1.45	1.67	1.97	2.22	2.49	2.90
3	0.258	0.64	0.97	1.10	1.28	1.55	1.81	2.06	2.39	2.77	3.16	3.55	4.12
4	0.349	0.87	1.31	1.48	1.74	2.09	2.44	2.79	3.23	3.75	4.28	4.80	5.58
5	0.452	1.13	1.70	1.92	2.26	2.71	3.16	3.62	4.18	4.86	5.54	6.22	7.24
6	0.569	1.42	2.13	2.42	2.84	3.41	3.98	4.55	5.26	6.12	6.97	7.82	9.10
8	0.841	2.10	3.15	3.75	4.20	5.04	5.89	6.73	7.78	9.04	10.3	11.6	13.5
10	1.16	2.90	4.35	4.93	5.80	6.96	8.12	9.28	10.7	12.5	14.2	16.0	18.6
12	1.54	3.85	5.78	6.54	7.70	9.24	10.8	12.3	14.2	16.6	18.9	21.2	24.6
14	1.97	4.92	7.38	8.37	9.84	11.8	13.8	15.8	18.2	21.2	24.1	27.1	31.6
16	2.45	6.12	9.18	10.4	12.2	14.7	17.2	19.6	22.7	26.3	30.0	33.7	39.2
18	2.98	7.45	11.2	12.7	14.9	17.9	20.9	23.8	27.6	32.0	36.5	41.0	47.6
20	3.56	8.90	13.4	15.1	17.8	21.4	24.9	28.5	32.9	38.3	43.6	49.0	57.0
25	5.25	13.1	19.7	22.3	26.2	31.5	36.8	42.0	48.6	56.4	64.3	72.2	84.0
30	7.26	18.2	27.2	30.8	36.4	43.6	50.8	58.1	67.2	78.0	88.9	99.8	116.2
40	12.3	30.8	46.1	52.3	61.6	73.8	86.1	98.4	113.8	132.2	150.7	169.1	196.8
50	18.6	46.5	69.8	79.0	93.0	111.6	130.2	148.8	172.0	200.0	227.8	255.8	297.6
60	26.2	65.5	98.2	111.4	131.0	157.2	183.4	242.4	242.4	281.6	321.0	360.2	419.2

[1]To convert the A' values in this table to other R values, use the following multipliers:
2 for R = 50; 3 for R = 75; 4 for R = 100; 6 for R = 150; etc.

From Tables 1 and 2 the water erosion hazards and limits can be assessed and assigned. The rating limits assume all vegetation has been removed and the "C" value of 1 is used. Since only in extreme cases all the vegetation is removed, there should be a modifier to stop all activity when vegetative cover is reduced to some assigned value, such as 10 percent, which is not proposed at this time.

The wind erodibility can be estimated by using the erodibility groups from on the northern great plains. Table 3 is the wind erodibility grouping. The erodibility is a measure of the relative cohesiveness of each soil texture.

Table 3. Wind erodibility soil groups in the Northern Great Plains

For use in predicting soil losses by wind and determining alternative land treatments for soil protection.

Wind Erodibility Soil Group[1]	Predominant Soil Classes
1	Very fine, fine, and medium sand and dune sand
2	Loamy very fine, fine, and medium sands
3	Very fine, fine, medium, and coarse sandy loams
4	Clays, silty clays (subject to granulation)
5	Loams, sandy clay loams, sandy clays
6	Silt loams, clay loams
7	Silty clay loams, silt
8	Soils subject to wetness, stoniness, etc., and not subject to wind erosion

[1]Group 1. Mostly dune sand; single grain structure; vegetation difficult to establish; not suitable for cropland.

Group 2. Mostly loamy sands; dry clod structure (as indicated by percentage of dry soil aggregates>0.04mm in diameter) is weak; requires a combination of intensive practices to control wind erosion.

Group 3. Mostly sandy loams; dry clode structure moderately stable; requires at least two measures to control wind erosion in regions with high and intermediate climatic factor.

Group 4. Mostly clays and silty clays; dry clode structure extremely variable due to contraction and swelling by freezing and thawing and wetting and drying; need a combination of at least two measures in regions with high and intermediate climatic factor.

Group 5. Mostly loams and sandy clay loams; dry clod structure quite stable; a combination of at least two measures is needed in a region with high climatic factor.

Group 6. Mostly silt loams and clay loams; dry clod structure stable; require a combination of at least two measures in a region with high climatic factor.

Group 7. Mostly silty clay loams; dry clod structure extremely stable; usually a single practice is sufficient to control wind erosion.

Group 8. Soils not suitable for crops because of wetness, stoniness, etc.

Table 4 is a comparison of the USLE method and the A'=KSR method for rating water erosion hazard as it applies to mapped soils in the Coachella Valley area. Only one soil, the Carsitas, resulted in a different limitation by the A' method.

Table 5 shows limitations of soils within the Coachella Valley area, some of which are in the Johnson Valley to Parker race area.

The WRTSSWPC criteria seems to consider three very important properties: water erosion, wind erosion, and bearing strength. These three properties should be considered prior to establishing a ORV course in undisturbed areas.

Table 4. Comparison of the USLE method and the A'=KSR method for rating the water erosion hazard for the mapping units of the Conchella Valley area. For the USLE, L = 100', R = 25; and C = 1.0.

Mapping Unit	K	T	Medial S	Medial S	A	Erosion Limitation	A'	Erosion Limitation
BA, Badland, 30-50%	0.15	1	40	12.3	46.9	Severe	46.2	Severe
BP, Borrow Pits, 0-2%	0.24	1	1	0.12	0.8	Slight	0.8	Slight
BtE, Bull Trial ST-SL, 9-30%	0.24	5	20	3.56	24.6	Severe	21.2	Severe
CaD, Cajon SL, 5-15%	0.15	5	10	1.16	4.9	Slight	4.2	Slight
CcD, Cajon, rocky variant, 2-15%	0.15	5	8	0.84	3.8	Slight	3.2	Slight
CcC, Carrizo ST-S,2-9%	0.10	5	6	0.57	1.6	Slight	1.5	Slight
CdC, Carsitas GR-S, 0-9%	0.10	5	5	0.45	1.3	Slight	1.2	Slight
CdE, Carsitas GR-S, 9-30%	0.10	5	20	3.56	10.2	Severe	9.0	Moderate
CfD, Carsitas S, wet, 0-5%	0.10	5	3	0.26	0.7	Slight	0.8	Slight
CnC, Carsitas CB-S, 2-9%	0.10	5	6	0.57	1.6	Slight	1.5	Slight
CnB, Carsitas FS, 0-5%	0.15	5	3	0.26	1.0	Slight	1.0	Slight
CnD, Carsitas, shallow variant, 2-5%	0.15	1	4	0.35	1.5	Moderate	1.2	Moderate
CnE, Carsitas, shallow variant, 5-23%	0.15	1	18	2.98	12.8	Severe	11.2	Severe
CnC, Chuckawalla CB-FSL, 2-9%	0.24	5	6	0.57	4.0	Slight	3.5	Slight
CnE, Chuckawalla CB-FSL, 9-30%	0.24	5	20	3.56	24.6	Severe	21.2	Severe
CoB, Chuckawalla GRV-SCL, 2-5%	0.15	5	4	0.35	1.5	Slight	1.2	Slight
CoD, Chuckawalla GRV-SCL, 5-15%	0.15	5	10	1.16	4.9	Slight	4.2	Slight
CpA, Coachella FS, 0-2%	0.15	5	1	0.12	0.5	Slight	0.5	Slight
CpB, Coachella FS, hummocky, 2-5%	0.15	5	4	0.35	1.5	Slight	1.2	Slight
CrA, Coachella FS, wet, 0-2%	0.15	5	1	0.12	0.5	Slight	0.5	Slight
CsA, Coachella FSL, 0-2%	0.15	5	1	0.12	0.5	Slight	0.5	Slight
Fa, Fluvaquents, 0-2%	0.37	5	1	0.12	1.2	Slight	1.0	Slight
Fe, Fluvent, 0-2%	0.37	5	1	0.12	1.2	Slight	1.0	Slight
GaB, Gilman LFS, 0-5%	0.20	5	3	0.26	1.4	Slight	1.2	Slight
GrA, Gilman FSL, 0-2%	0.37	5	1	0.12	1.2	Slight	1.0	Slight
GrB, Gilman FSL, 2-5%	0.37	5	4	0.35	3.7	Slight	3.2	Slight
GrA, Gilman FSL, wet, 0-2%	0.37	5	1	0.12	1.2	Slight	1.0	Slight
GsA, Gilman FSL, mod. fine substr., 0-2%	0.37	5	1	0.12	1.2	Slight	1.0	Slight
GeA, Gilman SIL, 0-2%	0.37	5	1	0.12	1.2	Slight	1.0	Slight
GfA, Gilman SIL, wet, 0-2%	0.37	5	1	0.12	1.2	Slight	1.0	Slight
Gp, Gravel pits and dumps	----	-	-	----	---	------	---	------
IeA, Imperial SIC, 0-2%	0.43	5	1	0.12	1.4	Slight	1.2	Slight
IfA, Imperial SIC, wet, 0-2%	0.43	5	1	0.12	1.4	Slight	1.2	Slight
ImC, Imperial-Gullied land complex, 2-9%								
-Imperial	0.43	5	6	0.57	7.1	Moderate	6.0	Moderate
-Gullied Land	0.43	1	6	0.57	7.1	Severe	6.0	Severe
Ip, Indio FSL, 0-2%	0.37	5	1	0.12	1.2	Slight	1.0	Slight
Ir, Indio FSL, wet, 0-2%	0.37	5	1	0.12	1.2	Slight	1.0	Slight
Is, Indio VFSL, 0-2%	0.55	5	1	0.12	1.8	Slight	1.8	Slight
It, Indio VFSL, wet, 0-2%	0.55	5	1	0.12	1.8	Slight	1.8	Slight
LR, Lithic Torripsamment-rock outcrop complex, 15-75% slopes								
-Lithic Torripsamments	0.15	1	40	12.3	46.8	Severe	46.0	Severe

Mapping Unit	K	T	Medial S	Medial S	A	Erosion Limitation	A'	Erosion Limitation
MaB, Myoma FS, 0-5%	0.15	1	3	0.26	1.0	Slight	1.0	Slight
MaD, Myoma FS, 5-15%	0.15	5	10	1.16	4.9	Slight	4.2	Slight
McB, Myoma FS, wet, 0-5%	0.15	5	3	0.26	1.0	Slight	1.0	Slight
NaB, Niland S, 2-5%	0.10	5	4	0.35	1.0	Slight	1.0	Slight
NbB, Niland S, wet, 2-5%	0.10	5	4	0.35	1.0	Slight	1.0	Slight
OnD, Onstott COSL, 5-15%	0.32	1	10	1.16	10.4	Severe	9.2	Severe
OR, Onstott-Rock outcrop complex, 5-50%								
-Onstott	0.32	1	30	7.26	64.0	Severe	58.0	Severe
RA, Riverwash, 0-5%	0.10	5	3	0.26	0.7	Slight	0.8	Slight
RO, Rock outcrop, 9-50%	0.0	-	30	7.26	0.0	Slight	0.0	Slight
RT, Rock outcrop - Lithic Torripsamments complex						(SEE LR AND RO)		
RU, Rubble land, 2-15%	0.1	5	8	0.84	2.5	Slight	2.0	Slight
Sa, Salton FSL, 0-2%	0.24	5	1	0.12	0.8	Slight	0.8	Slight
Sb, Salton SICL, 0-2%	0.37	5	1	0.12	1.2	Slight	1.0	Slight
SoO, Soboba, CB-S, 2-15%	0.15	5	8	0.84	3.8	Slight	3.2	Slight
SpE, Soboba ST-S, 5-30%	0.15	5	18	2.98	12.8	Severe	11.2	Severe
TO, Torriorthents-Rock outcrop complex, 9-50%	0.20	1	30	7.26	40.0	Severe	36.2	Severe
TpE, Tujunga FS, 5-30%	0.17	5	18	2.98	14.4	Severe	12.8	Severe
TrC, Tujunga GR-LS, 0-9%	0.15	5	5	0.45	2.0	Slight	1.8	Slight
TsB, Tujunga LFS, 0-5%	0.20	5	3	0.26	14.0	Slight	1.2	Slight

Table 5. Limitation ratings of the soils of the Coachella Valley Area for off-road wheeled vehicles using the WATSSWPC criteria

Mapping Unit	Water Erosion Limitation		Wind Erosion Limitation		Soil Strength Limitation		Overall Rating When Soil Surface Is:	
	A**	Rating	WEG	Rating	Unified	Rating	Moist	Dry
BA, Badland, 30-50%	46.2	Severe	2	Severe	SP-SM	Moderate	Severe, E.E.*	Severe, S.B.*.E.E.
BP, Borrow Pits	0.8	Slight	3-5	Moderate	ML,CL	Severe	Severe, L.S.*	Severe, L.S.
BtE, Bull Trail ST-SL, 9-30%	21.2	Severe	B?	Severe	SM	Moderate	Severe, E.E.	Severe, E.E.
CaD, Cajon LS, 5-15%	4.2	Slight	2	Severe	SM	Moderate	Moderate, L.S.	Severe, S.B.
CbD, Cajon Mesic variant, 2-15%	3.2	Slight	2	Severe	SM	Moderate	Moderate, L.S.	Severe, S.B.
CcC, Carrizo ST-S, 2-9%	1.5	Slight	1	Severe	SP	Moderate	Moderate, L.S.	Severe, S.B.
CdC, Carsitas GR-S, 0-9%	1.2	Slight	1	Severe	SP	Moderate	Moderate, L.S.	Severe, S.B.
CdE, Carsitas GR-S, 9-30%	9.0	Moderate	1	Severe	SP	Moderate	Moderate, E.E.,L.S.	Severe, S.B.
CfB, Carsitas S, wet, 0-5%	0.8	Slight	1	Severe	SM	Moderate	Moderate, L.S.	Severe, S.B.
ChC, Carsitas CS-S, 2-9%	1.5	Slight	1	Severe	SP	Moderate	Moderate, L.S.	Severe, S.B.
CkB, Carsitas FS, 0-5%	1.0	Slight	1	Severe	SM	Moderate	Moderate, L.S.	Severe, S.B.
CmB, Carsitas, shallow variant, 2-5%	1.2	Moderate	1	Severe	SM	Moderate	Severe, E.E.	Severe, E.E.,S.B.
CmE, Carsitas, shallow variant, 5-30%	11.2	Severe	1	Severe	SM	Moderate	Severe, E.E.	Severe, E.E.,S.B.
CnC, Chuckawalla CB-FSL, 2-9%	3.5	Slight	B?	Slight?	GM	Slight	Slight	Slight
CnE, Chuckawalla CB-FSL, 9-30%	21.2	Severe	B?	Slight?	GM	Slight	Severe, E.E.	Severe, E.E.
CnB, Chuckawalla GRV-SCL, 2-5%	1.2	Slight	B	Slight?	GM-GC	Moderate	Moderate, L.S.	Moderate, L.S.
CnD, Chuckawalla GRV-SCL, 5-15%	4.2	Slight	B	Slight?	GM-GC	Moderate	Moderate, L.S.	Moderate, L.S.
CpA, Coachella FS, 0-2%	0.5	Slight	1	Severe	SM	Moderate	Moderate, L.S.	Severe, S.B.
CpB, Coachella FS, hummocky, 2-5%	1.2	Slight	1	Severe	SM	Moderate	Moderate, L.S.	Severe, S.B.
CrA, Coachella FS, wet, 0-2%	0.5	Slight	1	Severe	SM	Moderate	Moderate, L.S.	Severe, S.B.
CsA, Coachella FSL, 0-2%	0.5	Slight	2	Severe	SM	Moderate	Moderate, L.S.	Severe, S.B.
Fa, Fluvaquents, 0-2%	1.0	Slight	B?	Slight	SM?	Moderate	Moderate, L.S.	Moderate, L.S.
Fe, Fluvents, 0-2%	1.0	Slight	3-5	Moderate	SM	Moderate	Moderate, L.S.	Moderate, S.B.,L.S.
GaB, Gilman LFS, 0-5%	1.2	Slight	1	Severe	SM	Moderate	Moderate, L.S.	Severe, S.B.
GbA, Gilman FSL, 0-2%	1.0	Slight	3	Moderate	ML	Severe	Severe, L.S.	Severe, L.S.
GbB, Gilman FSL, 2-5%	3.2	Slight	3	Moderate	ML	Severe	Severe, L.S.	Severe, L.S.
GcA, Gilman FSL, wet, 0-2%	1.0	Slight	3	Moderate	ML	Severe	Severe, L.S.	Severe, L.S.
GdA, Gilman FSL, mod. fine substr., 0-2%	1.0	Slight	3	Moderate	ML	Severe	Severe, L.S.	Severe, L.S.
GeA, Gilman SIL, 0-2%	1.0	Slight	6	Slight	ML	Severe	Severe, L.S.	Severe, L.S.
GfA, Gilman SIL, wet, 0-2%	1.0	Slight	6	Slight	ML	Severe	Severe, L.S.	Severe, L.S.
Go, Gravel pits and dumps	---	------	-	------	--	------	-----	------
IeA, Imperial SIC, 0-2%	1.2	Slight	4	Moderate	CH	Severe	Severe, L.S.	Severe, L.S.
IfA, Imperial SIC, wet, 0-2%	1.2	Slight	4	Moderate	CH	Severe	Severe, L.S.	Severe, L.S.
InC, Imperial-Gullied Land Complex, 2-9%								
-Imperial SIC	6.0	Moderate	4	Moderate	CH	Severe	Severe, L.S.	Severe, L.S.
-Gullied Land SIC	6.0	Severe	4	Moderate	CH	Severe	Severe, E.E.,L.S.	Severe, E.R.,L.S.
Ip, Indio FSL, 0-2%	1.0	Slight	3	Moderate	SM	Moderate	Moderate, L.S.	Moderate, S.B.,L.S.
Ir, Indio FSL, wet, 0-2%	1.0	Slight	3	Moderate	SM	Moderate	Moderate, L.S.	Moderate, S.B.,L.S.
Is, Indio VFSL, 0-2%	1.8	Slight	4L	Moderate	ML	Severe	Severe, L.S.	Severe, L.S.
It, Indio VFSL, wet, 0-2%	1.8	Slight	4L	Moderate	ML	Severe	Severe, L.S.	Severe, L.S.
LR, Lithic Torripsamments-rock outcrop complex, 15-75%								
-Lithic Torripsamments	46.0	Severe	1	Severe	SP-CM	Moderate	Severe, E.E.	Severe, E.E.,S.B.
MaB, Myoma FS, 0-5%	1.0	Slight	1	Severe	SM	Moderate	Moderate, L.S.	Severe, S.B.
MaD, Myoma, FS, 5-15%	4.2	Slight	1	Severe	SM	Moderate	Moderate, L.S.	Severe, S.B.
McB, Myoma FS, wet, 0-5%	1.0	Slight	1	Severe	SM	Moderate	Moderate, L.S.	Severe, S.B.
MaB, Milano S, 2-5%	1.0	Slight	2	Severe	SM	Moderate	Moderate, L.S.	Severe, S.B.
MbB, Milano S, wet, 2-5%	1.0	Slight	2	Severe	SM	Moderate	Severe, E.E.	Severe, E.E.
OnD, Onstott GSSL, 5-15%	9.2	Severe	3	Moderate	SM	Moderate	Severe, E.E.	Severe, E.E.
OR, Onstott-rock outcrop complex, 6-50%								
-Onstott part	58.0	Severe	3	Moderate	SM	Moderate	Severe, E.E.	Severe, E.E.
RA, Riverwash, 0-5%	0.8	Slight	B	Slight	GP-GM	Slight (SEE LR)	Slight	Slight
RT, Rock outcrop - Lithic Torripsamments								
RU, Rubble Land, 2-15%	2.0	Slight	B	Slight	GW	Slight	Slight	Slight
Sa, Salton FSL, 0-2%	0.8	Slight	3	Moderate	SM-SC	Moderate	Moderate, L.S.	Moderate, S.B.,L.S.
Sb, Salton, SICL, 0-2%	1.0	Slight	7	Slight	CL,CH	Severe	Severe, L.S.	Severe, L.S.
SoD, Soboba CB-S, 2-15%	3.2	Slight	B	Slight	GP-GM	Slight	Slight	Slight
SpE, Soboba ST-S, 5-30%	11.2	Severe	B	Slight	GP-GM	Slight	Severe, E.E.	Severe, E.E.
TG, Torriorthents-rock outcrop complex, 9-50%								
-Torriorthents	36.2	Severe	2	Severe	SM	Moderate	Severe, E.E.	Severe, E.E.,S.B.
ToF, Tujunga, FS, 5-30%	12.8	Severe	1	Severe	SM	Moderate	Severe, E.E.	Severe, S.B.
TrC, Tujunga GR-LS, 0-9%	1.8	Slight	2	Severe	SP-SM	Moderate	Moderate, L.S.	Severe, S.B.
TsB, Tujunga LFS, 0-5%	1.7	Slight	1	Severe	SM	Moderate	Moderate, L.S.	Severe, S.B.

*E.E. = Trafficability; S.B. = Soil blowing; and L.S. = Low strength

APPENDIX IV

Glossary of Selected Terms

Alluvial soil - A soil developing from recently deposited alluvium and exhibiting essentially no horizon development or modification of the recently deposited materials.

bedrock - The solid rock underlying soils and the regolith in depths ranging from zero to several hundred feet.

bisect - A profile of plants and soil showing the vertical and lateral distribution of roots and tops in their natural position.

buried soil - Soil covered by an alluvial, loessal, or other deposit, usually to a depth greater than the thickness of the solum.

calcareous soil - Soil containing sufficient free calcium carbonate or calcium-magnesium carbonate to effervesce visibly when treated with cold).1N hydrochloric acid.

class, soil - A group of soils having a definite range in a particular property such as acidity, degree of slope, texture, structure, land-use capability, degree of erosion or drainage.

classification, soil - The systematic arrangement of soils into groups or categories on the basis of their characteristics.

clay - A soil separate consisting of particles less than 0.002mm in equivalent diameter.

coarse fragments - Rock or mineral particles greater than 2,0mm in diameter.

coarse texture - The texture exhibited by sands, loamy sands, and sandy loams except very fine sandy loam.

colluvium - A deposit of rock fragments and soil material accumulated at the base of steep slopes as a result of gravitational action.

desert pavement - The layer of gravel or stones left on the land surface in desert regions after the removal of the fine material by wind erosion.

friable - A consistency term pertaining to the ease of crumbling of soils.

igneous rock - Rock formed from the cooling and solidification of magma, and that has not been changed appreciably since its formation.

parent material - The unconsolidated and more or less chemically weathered mineral or organic matter from which the solum of soils is developed by pedogenic processes.

ped - A unit of soil structure such as an aggregate, crumb, prism, block, or granule, formed by natural processes.

river wash - Barren alluvial land, usually coarse-textured, exposed along streams at low water and subject to shifting during normal high water.

sand - A soil particle between 0.05 and 2.0mm in diameter.

silt - A soil separate consisting of particles between 0.05 and 0.002mm in equivalent diameter.

soil horizon - A layer of soil or soil material approximately parallel to the land surface and differing from adjacent genetically related layers in physical, chemical, and biological properties or characteristics such as color, structure, texture, consistency.

soil series - The basic unit of soil classification being a subdivision of a family and consisting of soils which are essentially alike in all major profile characteristics except the texture of the A horizon.

soil structure - The combination or arrangement of primary soil particles into secondary particles, units, or peds.

soil survey - The systematic examination, description, classification, and mapping of soils in an area. Soil surveys are classified according to the kind and intensity of field examination.

soil variant - A soil whose properties are believed to be sufficiently different from other known soils to justify a new series name buy comprising such a limited geographic area that creation of a new series is not justified.

stratified - arranged in or composed of strata or layers.

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